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Geology and Mineral Resources
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Korea

By Kinosuke Inouye.

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Geology and Mineral Resources of Korea.

By KINOSUKE INOUE.

CHAPTER I. INTRODUCTION.

Korea projects southward from the main land of Manchuria, separating the Sea of Japan from the Yellow Sea, and Fu-san, a southern port, is within 12 hours from Shimonoseki in our Empire. So from the earliest period of our history the Japanese were in constant communication with the peninsula, especially through the free port of Fu-san. As to her geological structure it is early considered that she might have an intimate connection with the structure of East Asia and also of our Empire, but it is a regrettable matter that we have only a meagre literature concerning the geology of Korea. Dr. C. Gottsche¹ was the first who engaged in geological researches in Korea, and since then Messrs. Y. Ishii and K. Nishiwada made short journeys in the peninsula, their results being compiled in a revision of Dr. Gottsche's geological map of Korea.² Prof. B. Kotô spent in 1900—1902 about fourteen months in his travels over the peninsula, and his valuable and keen observations first appeared as 'An Orographic Sketch of Korea.'³ In 1903 and 1904 Mr. N. Yabe⁴ travelled through the southern part and made a rich collection of fossil flora, and owing to his study of this material the fossil-bearing formation extending on Kyöng-syang-do⁵ is ascertained to be the Jurassic. Beside

1. Gottsche: 'Geologische Skizze v. Korea.' Sitzber. der K. Pr. Akad. der Wissenschaft zu Berlin. XXXVI. 1886.
2. Geographical Journal of Tokyo. Vol. XII. 1900. (Japanese).
3. The Journal of Science, Imperial University of Tokyo. Vol. XIX. 1903.
4. The Journal of Science, Imperial University of Tokyo. Vol. XX. 1905.
5. The pronunciation of the geographical terms transliterated after Prof. Kotô and Kanazawa's system.

those above-mentioned, there are many data about the mineral resources of Korea, which are scattered in diverse publications. and which are not always reliable. Fortunately on the close of the Russo-Japanese war, a number of our geologists among whom I was enlisted, had an opportunity to engage in the geological survey of Korea.¹

From the reports and data provided by my colleagues, together with my own observations, I have been enabled to compile the annexed general geological map and the following pages as to the geology of Korea.

CHAPTER II. TOPOGRAPHY.

The topography of Korea is very complicated and its study will prove highly interesting. As Prof. Kotô stated in the paper above alluded to, Korea may be divided into two halves by Chuk-ka-ryöng Graben, which passes through the region from Yöng-heung Bay in the Sea of Japan, southwestward to Kang-hoa Bay in Yellow Sea. Each of these two halves has its own peculiarities, in topography, climate, history etc.

-
1. K. Inouye :—The mining industry of Korea. 1906 (Japanese).
 - K. Inouye & T. Niiyama :—Report on the mineral researches in Chyöl-la-do and Kyöng-syang-do. 1906 (Japanese).
 - T. Iki & S. Suzuki :—Report on the mineral researches in Hoang-hai-do, Kyöng-geui-do, South Chhyung-chhyöng-do & southern part of South Phyöng-an-do. 1906 (Japanese).
 - K. Nishio & H. Okada :—Report on the mineral researches in Kang-uön-do and North Chhyung-chhyöng-do. 1906 (Japanese).
 - S. Matsuda & S. Sasao :—Report on the mineral researches in Phyöng-an-do. 1906 (Japanese).
 - N. Kanehara & K. Nakagawa :—Report on the mineral researches in Ham-gyöng-do. 1906 (Japanese).

I. OROGRAPHY.

An excellent description of the tectonic features of Korea has been given in Prof. Kotô's paper above mentioned. So that I will here shortly describe only the principal mountain-chains which govern the present topography of Korea.

In the main, the mountain ranges of Korea run in one of three different directions, viz: N.—S., N.E.—S.W. and E.—W. They often intersect one another and give rise complicated relief.

1. South Korea —The main mountain ranges run either N.E.—S.W. or N.—S. Prof. Kotô's Han-san Ranges run almost parallel to the southern coast, that is, from E. by N. to W. by S., but they are often cut by rivers and inlets.

A range, beginning in the south of Nam-pho of South Chhyung-chhyöng-do, and running northeastward to Häing-chhi between Työng-san and Chhyöng-yang, passes to Chhya-ryöng between Kong-jyu and Thyön-an through the mountain masses between Kong-jyu and Tai-heung. Further northeast it follows the ridges between Thyön-an and Mok-chhyön and passes northeastward the boundary of Kyöng-geui-do and North Chhyung-chhyöng-do. It is cut by the upper Tai-dong-gang but again reappears beyond the river, forming Päik-un-san on the boundary of Kang-uön-do and North Chhyung-chhyöng-do. From the ridge between Phyöng-chhyang and Uön-jyu of Kang-uön-do, it runs to Mun-chhi-san, where it meets Prof. Kotô's Tai-päik-san Range. This range, corresponding to Prof. Kotô's Chhya-ryöng Range, consists of gneiss and granite and its direction coincides with the trend of the gneiss.

The second range which begins at the northwest of Ham-phyöng and over Ku-il-san, Pul-kap-san and Mal-chhi between Chyang-syöng and Yöng-goang, runs northnortheastward, forming No-ryöng o

porphyrite between Chyang-syöng and Chyöng-eup, and Man-ma-koan of clayslate between Im-sil and Chyön-jyu and still farther to Man-dök-san and Työng-nai-chhi between Chin-an and Chyön-jyu. From Ssari-ryöng between Yong-dam and Ko-san, it enters into the Palæozoic region and is cut at North Chhyung-chhyöng-do by the upper Keum-gang, reappearing beyond the river. It intersects the Tai-päik-san Range at the boundary of North Chhyung-chhyöng-do and North Kyöng-syang-do, and thence the mountains become higher and steeper, giving a grand aspect to the land. It bears away further to the northeast, forming the celebrated Syo-päik-san until it meets the coastal range, the Syo-päik-san Range. The southern part of this range corresponds to Prof. Kotô's No-ryöng Range. Though some areas in the middle are covered by the Palæozoic and the Mesozoic, and are disturbed by the eruptions of granite and porphyrite, yet the range generally conforms to the trend of the gneiss, running almost parallel to the Chhya-ryöng. These two ranges seem to be the oldest in Korea, constituting her foundation.

The third range trends almost from south to north near the eastern coast and corresponds to the meridian ridge of Prof. Kotô's Thai-päik-san Range. It begins from the rugged mountains, formed of green porphyrite, on the southwest of Fu-san, and runs northward with high and precipitous peaks of from 900 m. to over 1000 m., such as Chhyön-syöng-san, Un-mun-san, etc., which rise prominently above the hilly tracts of granite. The Range still keeps to the north and then enters into the region of clayslate and schalstein, followed by that of gneiss in N. of Kyöng-syang-do. Päik-pong-nyöng (over 1000 m.) of Kang-uön-do, formed of the Palæozoic, is the continuation of the Range, where the Range changes slightly to W., that is, in the direction of N.N.W. and forms high mountain masses

of over 1000 m., composed of gneiss and granite. Tai-koal-lyöng at W. of Kang-neung is followed by the mountain masses of O-dai-san and Thyön-hu-san, until the celebrated lofty mount, Keum-gang-san, is reached. The Range then gradually sinks toward N.W. and plunges into Yong-heung Bay at S.E. of Gen-san, reappearing at Ham-gyöng-do beyond the Bay.

The Range has a steep escarpment on the eastern coast, while it descends gradually or manifests plateau-like features to the west. Consequently when a traveller crosses the ridge from the east, he has to climb a steep pass; and from the west, he will, insensibly or by a short steep way, reach the top of the pass. This is a striking fact, showing the collapse of the eastern side of the Range by a dislocation in the meridional direction.

The fourth Range borders North Chhyung-chhyöng-do and North Chyöl-la-do with Kyöng-syang-do and corresponds to Prof. Kotô's Syo-päik-san Range. It forms a high range of more than 1000 m. on the northern boundary, as I-hoa-ryöng between Yönpung and Mun-gyöng; Ku-ong-bong; Sam-do-bong; Pong-hoang-san. It runs farther south to Pu-hang-nyöng between Chi-ryöi and Mu-jyu; Yuk-sim-nyöng between Chin-an and Kö-chhyang, and then links itself to the western part of Chi-ri-san. It is cut by Syöm-jin-gang and reappears beyond the river, forming Päik-un-san in South Chyöl-la-do. It then forms Syun-thyön peninsula which plunges under the sea in the south. It runs further northward from Tyo-ryöng-goan between Chhyung-jyu and Mun-gyöng, cut by the upper Han-gang. It reappears at North Chhyung-chhyöng-do and forms Syong-ak-san on the boundary of North Chhyung-chhyöng-do and Kang-uön-do. In Kang-uön-do it meets the Chhya-ryöng Range and Thai-päik-san Range. This Range is composed mainly of gneiss, except an area in the middle part, where it is covered by the Palæo-

zoic, interrupted by granite and porphyrite. Generally the range is high and steep, especially at the junctions with other ranges.

Two almost parallel ridges which run on both E. and W. sides of the Chyuk-ka-ryöng Graben are Koang-jyu Ridge and Ma-sing-nyöng Ridge, running regularly from S. to N. The Koang-jyu Ridge starts from N. of Koang-jyu, and over Tai-ma-san, composed of gneiss, it attains great height in the neighborhood of the boundary between Kyöng-geui-do and Kang-uön-do, the high peaks being Kuk-mang-san (over 1000 m.) in Kyöng-geui-do, Päk-un-san on the boundary, Pok-syu-san and Tai-syöng-san (over 1000 m.) in Kang-uön-do. The range can still be traced further to Thyöl-lyöng through a pass between Kim-hoa and Keum-syöng, and in Ham-gyöng-do it submerges under the sea. The Ma-sing-nyöng Ridge, starting in the Palæozoic region in N. of Kai-syöng, rises at Tai-ha-san and Hoa-kai-san in the granite on the boundary between Kang-uön-do and Ham-gyöng-do. From Ma-sing-nyöng of Ham-gyöng-do it sinks down into the Sea of Japan.

2. North Korea.—The topography of North Korea is highly complicated and forms high and steep mountains and plateaux over 1000 m.

The main ranges, Prof. Kotô's Liao-tung Ranges, run from E.N.E. to W.S.W. almost parallel to the trend of the gneiss. Three parallel ranges belonging to the Liao-tung Ranges can be traced. The Kal-eung-nyöng Ridge, the northern one, starts at the environs of Wi-jyu and runs E. N. E. to Kō-mun-san over 1100 m. and Pi-rai-san over 1400 m. After being cut twice by the tributaries of Am-nok gang, it reappears on E. intersecting the Nang-nim-san Range of the boundary of Phyöng-an-do and Ham-gyöng-do. It follows still the same direction along the boundary, forming Kal-eung-nyöng, until at last it is cut by the upper Am-nok-gang. In

fact, the ridge is a row of escarpments facing northward, and it lowers gradually to the south as a plateau. The Thök-yu-ryöng Ridge, the middle one, attains a great height in the north of Nang-nim-san and runs from Thök-yu-ryöng to Ku-kokäi and Ho-mi-ryöng, all more than 700 m. in height. It gradually descends west-southwest to Tai-nyöng-gang. In Ham-gyöng-do, the Ridge is interrupted by Chyang-jin-gang and Hö-chhyön-gang and not well defined. The former ridge forms indeed the watershed of Tai-nyöng-gang and Am-nok-gang and the latter of Chhyöng-chhyön-gang and Am-nok-gang. The Myo-hyang-san Ridge, the southern one, runs along the boundary of North and South Ph्यों-an-do, forming Koang-syöng-kokäi on the boundary. In the west of Myo-hyang-san, the Ridge is cut by Chhyöng-chhyön-gang. In Ham-gyöng-do we can recognise Hoang-chhö-ryöng, Pu-chyöl-lyöng and Hoang-chhi-ryöng on its continuation. After being cut by Nam-tai-chhyön and Peuk-tai-chhyön it reappears further eastnortheastward. These latter two Ridges are high and precipitous, forming mountain-chains of more than 1000 m. in height, with steep escarpments facing south

The Nang-nim san Range stretching from N. to S. on the boundary of Ph्यों-an-do and Ham-gyöng-do, may be considered as the relevation of the Syo-päik-san Range. It forms a high and steep mountain-chain of more than 1000 m. In the middle of the Range, there rises the high gneiss peak of Nang-nim-san; the pass of Koml san-nyöng (over 1200 m.) in the granite region in the north and A-deung-nyöng (over 1400 m.) in the gneiss in the south will here be noted. The Range can be followed still further northward, until cut by the upper Am-nok-gang.

The Ma-thyöl-lyöng Range starting at Päik-tu-san in Chyang-päik-san range of northern Ham-gyöng-do, runs southsoutheastward along the boundary of North and South Ham-gyöng-do. A thick

basalt flow covers the gneiss terrain, and forms a gigantic plateau from 1400 to 2000 m. high.

The Ham-gyöng Range trends N.E.—S.W. on the middle North Ham-gyöng-do, running almost parallel to the coast line. It begins at Un-mu-ryöng, W. of Kyöng-uön, near the northern boundary and runs from Ko-syöng-nyöng to Chhya-un-nyöng, where it meets the Ma-thyöl-lyöng Range, culminating at Chyak-ryöng over 1800 m. This Range together with Myo-hyang-san Range forms the watershed between the tributaries of Am-nok-gang and Tu-man, gang and of the rivers emptying into the Sea of Japan.

The southern part of North Korea is Prof. Kotô's Palæo-Chyo-syön Land. Though the mountains are insignificant in height yet they have a complicated orographic feature. Of the numerous ranges in the land, we will here mention four distinct parallel ridges running from E. to W. The northernmost Mi-ryöng Ridge which begins at N. of Eun-san, runs in the equatorial direction almost parallel to the strike of the Palæozoic strata, forming Mi-ryöng and Chhai-ryöng, and joins to the north of the granite ridge of Päik-tu-san. The next Range, lying on the south of the above and forming the watershed of North and South Tai-dong-gang, starts E. of Ph्योंg-yang, passes Chyöi-ryöng-san, and then runs further eastward, almost parallel to the strike of the Palæozoic strata, the average height being 500—800 m. The greatest elevation occurs in the granite region on the boundary of South Ph्योंg-an-do and Kyöng-geui-do, where rises Ha-ram-san more than 1300 m in height.

The Chyo-il-lyöng Ridge, starting in the midway between Chhyung-hoa and Hoang-jyu, runs from Syu-san and Tai-çhyhyöng-san to the solitary granite Öñ-jin-san over 1100 m. It stretches further eastward in the strike of the Palæozoic strata from Tai-kak-san to Päing-nyön-san on the boundary of Hoang-hai-do and Ham-gyöng-

do, and forms the watershed between Tai-dong-gang and Yöi-syöng-gang.

The Myör-ak-san Ridge traverses the middle Hoang-hai-do. Beginning at Chyang-san-kot, it passes from Pul-da-san of the Palæozoic through a gneiss region to Myör-ak-san over 800 m. of granite. After being cut by Yöi-syöng-gang, it rises again on the east, forming the Palæozoic Tai-dun-san and Syu-ryöng-san (over 600 m.) on the boundary of Hoang-hai-do and Kyöng-geui-do.

On the boundary of South Phyöng-an-do and southern South Ham-gyöng-do, we can follow a range running N.E.—S.W. whose geo-tectonic relation with others is not clear.

Besides those ranges, we have many other ridges in the peninsula, though they are often interrupted by rivers and inlets.

In short, North Korea is mountainous or plateauic, forming high and precipitous ranges over 1000 m. and giving gigantic and rugged features to the landscape. Consequently the plains and hills are limited only to small patches along the valleys and coast, except an area of the Palæo-Chyo-syön Land. On the other hand, South Korea, with the exception of the eastern coast and the boundary districts, consists of hills, or broad plains of rich and fertile soil lying among them.

II. HYDROGRAPHY.

The rivers of Korea flow naturally in three directions. As the meridional ranges lie close to the eastern coast, almost all the rivers that empty into the Sea of Japan are necessarily short, excepting one, the Tu-mun-gang, on the northern boundary.

North Korea.—Am-nok-gang and Tu-mun-gang flow in opposite directions towards W.S.W. and E.N.E. respectively. The Ma-thyöl-ryöng Range forms their watershed, Tu-mun-gang having a

much shorter course than Am-nok-gang. Along their tributaries in the peninsula, they form narrow cañons or foaming gullies, and we can scarcely find a single broad plain watered by any of them.

As the consequence of the situation of the Myo-hyang-san Range and Ham-gyöng Range, the rivers, pouring into the Sea of Japan, do not form large streams, though they often hinder local communications during the rainy season, without offering the advantages of navigation. Among them, the five rivers, Peuk-tai-chhyön, Nam-tai-chhyön, Sin-tai-chhyön, Syöng-chhyön-gang and Yöng-heung-ha are worthy of notice.

Among the rivers that empty into the Yellow Sea, Tai-nyöng-gang, Chhyöng-chhyön-gang, Tai-dong-gang, and Yöi syöng-gang are large and navigable. The Tai-nyöng-gang flows down southwards from Kal-cung-nyöng Ridge, and in passing the environs of Pak-chhyön, it turns to the southwest and unites with the Chhyöng-chhyön-gang near the mouth. On its upper courses, the mountains standing close to the banks, the river has scarcely any plain on either side, but on the south of Thai-chhyön, it enters into a plain and is navigable to the north of the town.

The Chhyöng-chhyön-gang rises in the Thök-yu-ryöng Ridge. Its main course is S.W., leaving a few plains along the banks, till Syöi-chhyang, N.W. of Kai-chhyön, is reached. The district over 20 ri¹ from Syöi-chhyang to the mouth is a vast fertile plain. It receives on the west of Syöi-chhyang a large tributary, the Kuryöng-gang, which runs down southward from Ho-mi-ryöng. It is navigable by steamer up to An-jyu; by junk up to Heui-chhyön along the main course and also up to 15 ri along the Kuryöng-gang. The Chhyöng-chhyön-gang from Nam-djyön, E. of

1. Japanese measure of length. 1 ri = 3927, 27 meters.

Yöng-pyön, runs in a straight line to its mouth. Its southern part is made up of the Palæozoic, and the general strike of gneiss differs in its N. and S. From this fact, we may conclude that the lower Chhyöng-chhyön-gang flows down along a fault, which seems to correspond to the escarpment of Prof. Kotô's Tu-kai Ridge.

South Phyöng-an-do is drained by the Tai-dong-gang, whose main course rises in the south of Nang-nim-san and runs down west-southwestward, receiving numerous tributaries in its course. Receiving large affluents, the Pi-ryu-gang and South Tai-dong-gang, it grows broader and deeper, and near its mouth it joins the navigable Chai-ryöng-gang. Large steamers can go up to Kyöm-i-pho, launches up to Phyöng-yang and junks up to Ko-dong of Eun-san, N. of Apeun-san Mine, in the main course, to Syöng-chhyön in Pi-ryu-gang and Mun syöng-jyang of Kok-san, 30 ri from Phyöng-yang, in South Tai-dong-gang.

Yöi-syöng-gang, that drains east Hoang-hai-do, flows southward and is navigable for launches to Chyo-pho, 6 ri from the mouth, during the high tide. Im-jin-gang, taking rise at S. of Ma-sing-nyöng, in Ham-gyöng-do, runs down to southsouthwestward, collecting waters in Chyuk-ka-ryöng Graben, and enters Han-gang, after receiving a large affluent which drains Phyöng-gang and Thyöl-uön in Kang-uön-do.

South Korea.—As the Tai-päik-san Range stretches near the eastern coast, the rivers that flow into the Sea of Japan are necessarily short. The larger of them have their longer course in the direction from N. to S., perhaps running along the faults. On the contrary, we can enumerate large rivers that empty into the Yellow Sea and straight to the south. The general direction of these rivers is S.W. or S.S.W. or is at right angles to it, only Nak-töng-gang between the Syo-päik-san and Tai-päik-san Ranges, flowing down from north to

south. Broad fertile plains are found everywhere along the rivers and the coast.

Han-gang, the largest and longest river in Korea, drains the southern Kyöng-geui-do, western North Chhyung-chhyöng-do and Kang-uön-do. Its northern main course takes rise in the Tai-päik-san Range near Hoi-yang and passing through Keum-syöng and Nang-chhyön, and receiving two large tributaries, Syo-yang-gang at Chhyun-chhyön and Hong-chhyön-gang at the south of Ka-phyöng, it is joined by the southern main course. The southern main course, which rises in Tai-koan-nyöng of the Tai-päik-san Range, and collects the waters of southern Kang-uön-do, runs down southward, and turns west in North Chhyung-chhyöng-do on passing Chyöng-syön and Yöng-uöl. Draining the plains of Yöng-chhyun, Tan-yang, Chhyöng-phung, Chhyung-jyu, it again turns to N.W. and joins the northern course, where it swells into a wide and deep stream. After winding gently round the south of Seoul, it receives the great Im-jin-gang near its mouth and enters into the sea to the north of Kang-hoa Island. Launches can be used to the south of Seoul and junks to Nang-chhyön through Chhyun-chhyön in the northern main course and Yöng-chhyun in the southern.

Keum-gang takes rise in the boundary district of Chyöl-la-do with Kyöng-syang-do and runs down to the north. It turns west in the district between Chhyöng-san and Ok-chhyön and receives a large affluent at Yön-gi, which flows southward along the eastern foot of the Chhya-ryöng Range. It again turns southward at Kong-jyu and after passing through Pu-yö and Syök-syöng, it turns S.W., and enters into the sea, the port of Kun-san harbour being situated near its mouth. From Kun-san to Kang-gyöng, the river is navigable for launches and to Pu-gang station through Kong-jyu for junks.

The Yöng-gang which rises in Chhyu-uöl-san of the No-ryöng

Range, runs down S.S.W., and draining the plains of Koang-juu and Na-juu, and receiving a large tributary at the north of Na-juu, it turns to the S.W. Mok-pho is a port situated at its mouth. For junks, it is navigable to Yöng-san-pho, 12 ri from Mok-pho.

The Syöm-jin-gang which rises in Man-dök-san of the No-ryöng Range, runs down S.W. and turns to the south at N.W. of Kal-dan and then again to the S.E. It is fed by numerous tributaries, two of which deserve mention. One has its source in the Syo-päik-san Range and drains Nam-uön and Kok-syöng and the other rises in the Han-san Range on the southern coast and runs N.E.

The Nak-tong-gang, bounded by the watersheds of the No-ryöng, Syo-päik-san and Tai-päik-san Ranges, drains almost all part of Köyng-syang-do, except a narrow area along the sea coast. Two large streams joining at the south of Yong-gung, are its main courses, which run directly S. Receiving the Yong-gang, the largest affluent in the south of Chhyang-nyöng, it waxes into a great and wide stream and then turns to the E. on encountering the Han-san Range along the southern coast. As its main course in North Kyöng-syang-do flows near the Syo-päik-san Range, the tributaries that flow from the Tai-päik-san Range, are long and large, and form wide drainage areas and gentle streams, while those from the Syo-päik-san Range are comparatively short and form rather a rapid current. In South Kyöng-syang-do, though it flows in the middle of two ranges, the tributaries from the E. are shorter and more rapid as the river turns to the E. It is navigable as far as Nak-tong, 45 ri from its mouth.

Generally speaking, the rivers seem to follow the same direction as the mountain ranges; that is, they seem to have sought their easiest course along the faults, resulting from the earth-disturbances which the mountain ranges have also suffered.

III. COAST LINE.

The eastern coast is generally abruptly cut off and borders the sea with cliffs, poor in indentation. The western and southern coasts, on the contrary, have numerous inlets and islands, forming several excellent harbours.

Eastern Coast.—Nan-to Bay (Ung-keui Bay) lies near the northern boundary and Chyo-syön Bay in the middle, with the port of Gen-san (Wön-san) in the S.W. of the bay. Yong-il Bay is situated in the middle of Kyöng-syang-do. The northern coast of Yong-il peninsula plunges sheer and steep into the sea, the prolongation of the coast line passes through Yong-il plain and is connected with the main course of the Keum-ho-gang, a tributary of the Nak-tong-gang, in a straight line, which seems to correspond to a fault.

Western Coast.—On the north lies Korea Bay, the Chhyöng-chhyön-gang emptying its waters in the north of the bay and the Tai-dong-gang in the south. The wellknown harbour of Chin-nam-pho is situated at the mouth of the Tai-dong-gang. At the middle we see the large Kang-hoa Bay, on the north of which Hai-jyu Bay indents further landward, and on the south, Nam-yang Bay. At the east of the Kang-hoa Bay there lies the important Ché-mul-pho, surrounded by numerous islands. On S. of Kang-hoa Bay, Nai-pho enters deeply toward N., and is sheltered on the west by the Thai-an peninsula and An-myon-do. Though we see numerous inlets, on the south, yet they are all shallow and marshy and are not fit for the anchorage of large steamers, except the port of Mok-pho, at the mouth of the Yong-gang, sheltered by promontories and islands, though its entrance is very narrow and dangerous.

Islands are not abundant at the north of the Chyang-san-kot, the western promontory of Hoang-hai-do, yet there lie more than

ten islands, arranged in a row at the mouth of the Chhyöng-chhyön, gang and the Tai-dong-gang and the south-western coast of Hoang-hai-do, the largest being Sin-mi-do at the mouth of the Chhyöng-chhyön-gang. In Kang-hoa Bay, we see numerous islands, arranged in the directions, E.—W. and N.E.—S.W., the largest being Kang-hoa Island at the mouth of the Han-gang. Numerous islands in rows, generally running N.E. or N.N.E.—S.W. or S.S.W., are scattered from the south of Kang-hoa Bay to Mok-pho. Indeed, the arrangement of the islands must have some intimate relation with the formation of the mountain ranges, for the both directions are generally same. As the harbours lie in the mouth of large rivers they are shallow and marshy and not very suitable for the anchorage of large steamers or for communication with the lands. Chin-nam-pho, Che-mul-pho, Kun-san and Mok-pho are noteworthy here.

Southern Coast.—The Southern coast ranks first in coastal development and it has intimate connections with Porf. Kotó's Korean and Hansan Ranges. Indentations, promontories and islands lie in the same direction with those mountain ranges, that is, in the two directions of N.—S. and E. by N.—W. by S. Generally the bays are protected from the wind, being sheltered by the promontories and islands at the front, and form excellent natural harbours, the depth of the sea-bottom being often suitable for the anchorage of large steamers. The famous Ma-san Bay and Chin-hai Bay encroaches further on the land with Kō-jyōi Island in front. In the west of Chin-hai Bay there lie Chin-jyu Bay and Koang-yong Bay, separated by Nam-hai Island. Though they are sheltered by the island and peninsulas, yet they are rather shallow for the anchorage of large steamers, as the Syöm-jin-gang and other rivers discharge their silt into them. Still to the west, we see two large inlets, Syun-chhyön Bay and Po-syöng Bay, separated

by Heung-yang peninsula, their sea bottom being rather shallow, the latter of only 4—5 fathoms. Kang-jin Bay lies west of the latter, sheltered by O-an-do. Fu-san (Pu-san) sheltered by Chyöl-yong-do is the entrance port of Korea from the south and has facilitated communications between our Empire and the peninsula.

Among many hundreds of islands we can enumerate some large ones: Kō-jyōi-do, Nam-hai-do, Chin-do and the largest Chyōi-jyu-do etc.

CHAPTER III. GEOLOGY.

The rocks which enter into the structure of Korea may be classified as follows :

- I. Gneiss.
- II. Palæozoic.
 1. Kun-san Formation.
 2. Phyllite Formation.
 3. Korean Formation.
 4. Fusulina Limestone.
- III. Mesozoic (Jurassic)
- IV. Tertiary.
- V. Quaternary.
 1. Diluvium.
 2. Alluvium.
- VI. Granite.
- VII. Porphyry.
- VIII. Porphyrite.
- IX. Andesite and its Agglomerate.
- X. Basalt.

The foundation of Korea is formed of gneiss, which is often accompanied by large masses of granite. Its distribution is so wide that the area of over one half of the whole peninsula is composed of it. The Palæozoic comprises four formations. The Kun-san Formation is considered to be the lowest and is only found in the environs of Kun-san. This Formation as well as the Phyllite Formation, includes a number of rocks of different characters, all of which have common habits of being intensely metamorphosed. Their mutual relation is however of a puzzling question. The Phyllite Formation occupies a few detached patches and might represent a part of Richthofen's Ta-ku-shan Formation, but we can not find an unconformability with the overlying Korean Formation. The Korean Formation appears in two large areas in South Ph्योंg-an-do and Kang-uőn-do, besides in smaller scattered areas. It partly presents Richthofen's Sinian Formation, the greater part being deep-sea facies with limestone in predominance. I propose to call this Formation the Korean Formation in contradistinction to the Sinian Formation, with which the relation is not yet clearly ascertained. The Fusulina Limestone is a thick complex of limestone, a part of which contains *Fusulina*, *Schwagerina* etc. It forms low karst-like plateaux, quite different from mountains formed of limestone of the Korean Formation. The Mesozoic occupies a wide area in Kyőng-syang-do, and elsewhere in small scattered areas, generally deposited in the basins of the older rocks. By the evidence of the fossil flora, discovered in Kyőng-syang-do and South Ph्योंg-an-do, the strata were ascertained to belong to the Jurassic. During the long interval between the Archæan and Mesozoic eras, great eruptions and intrusions of granite, porphyry and porphyrite took place very frequently and the present configuration of Korea was already shaped before the beginning of the Tertiary era. The Tertiary

occupies only a few small areas on the eastern coast and the Quaternary forms terraces and plains along rivers and coasts. The volcanic activity of the Cainozoic era is only displayed in the conspicuous basalt flow in the north and a few andesite and basalt intrusions or flows. Plate I (fig. 1 and 2) contains profiles of the southern and middle parts of Korea which enable us to understand the general disposition of different rocks represented.

I. GNEISS.

The gneiss, as already stated, has the largest extension in the peninsula and occupies three large areas, beside small scattered patches. It consists mainly of granite-gneiss, interbanded with biotite-gneiss, hornblende-gneiss, mica-schist and sometimes with quartz-schist, pyroxene-schist and crystalline limestone. The schistosity is often not distinct, and difficult to distinguish from schistose granite.

1. Northern Area.—The gneiss occupies a large area in the north, extending on North Phyöng-an-do and South Ham-gyöng-do. It consists principally of hornblende-granite-gneiss and biotite-granite-gneiss with two-mica-gneiss, hornblende-gneiss and biotite-gneiss. Two-mica-gneiss is especially developed in the gneiss in the south of An-jyu and the environs of Yöng-pyön and Wi-jyu. Garnet is abundantly found in granite-gneiss or biotite-gneiss in the east and south of Ui-uön and the environs of Työng-jyu and Ka-san, and eye-gneiss with large felspar crystals is found at Kal-eung-nyöng Range between the south of Chhyöng-syöng in Ui-jyu and the south of Sak-jyu and Thök-yu-ryöng Range from Kui-syöng to Un-san,

In Phyöng-an-do, the general strike of gneiss is E.N.E.—W.S.W. with the dip of N.N.W, 50° - 70° , but sometimes S.S.E., forming anticlinals and synclinals. In Ham-gyöng-do it runs from N.E. to

S.W. but in the area enclosed by Kap-san, Peuk-chhyöng and Tan-chhyön, it holds the general strike N.—S., and between Pu-ryöng, Mu-san and Hoi-ryöng it strikes almost from east to west.

The district which stretches from the south of An-jyu southwards along the coast of South Phyöng-an-do consists mainly of granite-gneiss intercalated with two mica-schist and biotite-gneiss. Its strike seems to run parallel to the boundary line with younger formations, that is, in the north it is N—S or N.N.E.—S.S.W. and in the south N.N.W.—S.S.E., generally dipping to the east.

2. Middle Area.—The large area of the gneiss of North Chhyung-chhyöng-do and Kang-uön-do, is separated by an enormous mass of granite into two parts. The rocks are similar to those found in the northern area. Eye-gneiss, with large felspar crystals measuring 1—3 inches, is found in the environs of Yang-yang. We see granite-gneiss intercalating fine grained mica-schist at Chhya-ryöng Range of the south of Seoul, and dark green chlorite-biotite-schist at Chik-san mine.

The schistosity is not always distinct but the strike seems to be generally N.N.E.—S.S.W., often N.E.—S.W. and sometimes E.N.E.—N.S.W. The dip is generally W.S.W. 40° – 50° but sometimes E.N.E.

3. Southern Area.—The gneiss which extends in Chhyöl-la-do and in the west and north of Kyöng-syang-do, like the areas above, consists mainly of granite-gneiss, intercalated with gneisses of different characters and intruded by abundant dikes and sheets of porphyries and porphyrites. I shall describe here some rock facies worthy of notice. The tract from the east of Mu-jyu eastwards, is composed of biotite-gneiss, hornblende-gneiss, two-mica-gneiss, hornblende-schist and lacking granite-gneiss. Two mica-gneiss, some of which contain tourmaline and garnet, is developed between Chin-an and Chyang-gyöi-nyang, about 5 ri east of Chin-an. Garnet-

muscovite-gneiss is found between Ku-ryōi and Kok-syōng and muscovite-gneiss between Pon-hoa and Yōi-an in north Kyōng-syang-do. Hypersthene-biotite-gneiss at the south of Pok-nāi-jyang, north of Po-syōng, augite-hornblende-biotite-gneiss at Sai-mok, southwest of Syōng-jyu, augite-gneiss at in (Ma-gok Chin-po), augite-biotite-gneiss at Pong-hoa, augite-schist at the south of Keum-gu and graphite-biotite-gneiss at Yang-bang, west of Ham-chhyang, will be here mentioned. Beside the rocks mentioned above we see biotite-schist and quartz-schist, which do not generally form a thick complex. The characteristic of gneiss of Chi-ri-san and its environs is the presence of large crystals of white and red felspar measuring 5—6 inches.

The general strike seems to be N.N.E.—S.S.W. in the south and middle and N.E.—S.W. in the north and east of Chyōl-la-do, and the dip is generally N.W. or S.E.

II. PALÆOZOIC.

In Palæozoic I include some metamorphic and sedimentary rocks. Though their geological horizon and consequently their ages are not yet thoroughly worked out on the palæontological ground, we can classify them into four formations by their petrographical and stratigraphical relations.

1. *Kun-san Formation.*

The Formation which stretches from Kun-san eastwards to Ham-yōl consists mainly of mica-schist, hornblende-schist, with thin layers of quartz-schist. At the environs of Kun-san, mica-schist alternates with hornblende-schist and often decomposes into red or brown clay. The strike is E.—W. dipping steeply to S. or almost vertically. In the west of Ham-yōl, mica-schist predominates, alternating with quartz-schist and hornblende-schist. The strike

is E.N.E.—W.S.W, and the dip is almost vertical. The rocks are all highly metamorphosed and some resemble crystalline schists of the gneiss. In connection with Phyllite Formation I venture to describe the complex preliminarily under the Palaeozoic, and to call it the Kun-san Formation, until more detailed study in the future modify the view. Its relation with the Phyllite Formation is quite ambiguous, but it seems to me that the rocks belonging to the former are much more metamorphosed than the Phyllites.

2. *Phyllite Formation.*

The Phyllite Formation consists of mica-schist, hornblende-schist, quartz-schist and phyllite, and greatly resembles the Kun-san Formation, though the rocks are much less metamorphosed than those of the latter. A part of this formation seems to represent certain horizon of the Ta-ku-shan Formation, as seen in the environs of Sang-nyöng.

Along the coast between Yu-syöng and Pu-kö, about $3\frac{1}{2}$ ri north of Kyöng-syöng, in North Ham-gyöng-do, the alternation of chlorite-phyllite and graphite-phyllite together with felspar phyllite are found. They dip N.E. 25° at the east of Yusyöng.

In the environs of An-hyöp, Thyöl-uön, Sang-nyöng, Yön-chhyön near the boundary district of Kyöng-geui-do and Kang-uön-do, the Phyllite Formation is overlaid conformably by the lower part of the Korean Formation. The upper horizon consists mainly of black phyllite and the lower of mica-schist, sometimes with chlorite-schist, the strike being N. 80° E. and the dip northwards.

The small scattered area in Chyöl-la-do is composed of quartz-schist, muscovite-quartz-schist and thin layers of limestone, beside hornblende-schist, mica-schist and phyllite.

Between Yö-san and Chin-san, mica-schist, quartz-schist and black phyllite with thin beds of limestone are found. Mica-schist

develops well near Yö-san, quartz-schist at the north of Ko-san and black phyllite in the region of Yö-san and Chin-an. A somewhat thick bed of limestone is found on Thyön-ho-san. The strikes of the strata is generally E.N.E.—W.S.W. The dip is N. or S. 40° — 30° forming anticlinals and synclinals, or sometimes vertical.

At Hyön-näi, southeast of Keum-san, is found an alternation of mica-schist and quartz-schist, intercalating thin beds of crystalline limestone, with steep inclination toward N.N.W.

A small area at the north of Mu-jyu consists of hornblende-schist, quartz-schist and phyllite with the strike of E.N.E.—W.S.W. forming a synclinal in the middle.

Between Ham-phyöng and Mu-an there develop quartz-schist, quartz-muscovite-schist and phyllite, generally quartz-schist in the north and phyllite in the south.

The long extended area from Tong-pok to Ok-koa is composed of a thick complex of quartz-schist, quartz-muscovite-schist, phyllite and schalstein. Quartz-schist, phyllite and schalstein are found at the southwest of Tong-pok, and at Tok-chhi spotted hornblende-schist alternates with quartz-schist, intercalating metamorphosed sandstone and phyllite, and dips steeply toward W. N. W. Chho-gyöi-san which stands at the east of the upper Syöm-jin-gang, E. of Syun-chhyang, is composed mainly of quartz-schist and quartz-muscovite-schist, with interbedded black and green phyllite, the dip being E. or E.S.E. 40° — 70° . It overlies gneiss unconformably and extends further toward north and south. Between Syun-chhyang and Ok-koa the alternating strata of biotite-schist, muscovite-schist, spotted biotite-schist, graphite schist and quartz-schist dip to S. 35° and seem to be much more metamorphosed than those stated above, but I can not recognise any sharp division-line between them, so that I have classified them under the same formation.

The rocky range in the south of Kang-jin and Chyang-heung consists mainly of quartz-schist and muscovite-quartz-schist which run from E.N.E. to W.S.W, following the direction of the mountain range, with general dip toward N.N.W. The topographic and geologic features are quite similar to those of Chho-gyöi-san.

3. *Korean Formation.*

The lower part of the Korean Formation consists mainly of quartzite, clayslate and sandstone, and the upper of limestone and marl. Quartzite is white or greyish white, hard and compact; clayslate generally black but often greenish; sandstone fine to coarse-grained, generally grey in color and often passes into conglomerate, and limestone is massive, being black or dark grey in color. These rocks partly suffer metamorphism, and consequently quartzite sometimes passes into quartz-schist, and clayslate to mica-schist, while limestone is often schistose and crystalline. The Formation is considered to represent Cambro-Silurian, but without sufficient Palæontological grounds, only by its similarity with the Sinian Formation and the imperfect fossils in North Ph्यों-an-do.

The wide area in South Ph्यों-an-do and Hoang-hai-do and in the northern corner of Kyöng-geui-do and Kang-uön-do, consists of quartzite, clayslate and sandstone with thin beds of limestone in the lower horizon, and limestone and marl in the upper. The distribution of the lower horizon is rather limited or it is generally developed in the margins; that is, from Chhyöng-chhyön-gang to the neighborhood of Chho-eum-nyöng, north of Yöng-uön; environs of Syunchhyön and Chä-san; from Nam-djyön of Syöng-chhyön to the south of Mäing-san; from the north of Pong-san to the road between Syuan and Syo-heung; near Mun-syöng-jyang, north of Kok-san, the environs of Sang-nyöng and Keum-syöng. The remaining parts are mainly composed of thick beds of limestone and marl, intercalat-

ing thin clayslate, rarely sandstone, conglomerate and schalstein. Clayslate along the margin is often metamorphosed and is schistose, sometimes passing into mica-schist or chlorite-schist. Quartz-schist and schistose limestone are found in the environs of Sang-nyöng and Keum-syöng. The limestone of So-min-dong of Yöng-pyön, north-west of Tök-chhyön, contains indeterminable fossils, considered as corals. In the pass between Tök-chhyön and Yöng-uön and in the environs of To-mak-dong of Mäing-san wormy limestone is found.

The strike differs in the north and south of the Chyo-il lyöng Range, showing the existence of a great fault along the mountain axis. In the south it is E.—W. with two or three foldings, while in the north it is generally W.N.W.—E.S.E. but often E.—W. or E.N.E.—W.S.W. with many foldings and faults, being more disturbed than the former.

Near gneiss it is often N.—S. instead of being E.—W. and the dip is W. in the eastern part and E. in the western; that is, the strike generally shows the coincidence along the boundary line with gneiss, while in the middle part it holds the folding axis of E.—W., the formation being deposited in the basin of gneiss.

The Korean Formation which extends from Kang-neung and San-chhyök on the eastern coast, further southwestward to Chhyung-ju, generally holds the strike of N. 40°—60° E. The dip is sometimes N.W. or S.E., forming many foldings. But in the district, a few ri around Nyöng-uöl, the strike is N.—S., and the dip is generally W. 50°-60° or often vertical. Near the eastern coast the Formation is often so disturbed, that we can hardly find out the general strike.

The rocks are clayslate, sandstone, conglomerate, schalstein and limestone, and lack quartzite in the lowest horizon. Limestone forms thick deposits in the area, bounded by Nyöng-uöl and Chyu-chhyön, W.N.W. of Nyöng-uöl and also by Chhyöng-phung and

Tan-yang. In the southwest of the area clayslate seems to be much developed. These rocks have often suffered contact-metamorphism by such as granite, porphyry and porphyrite. In the south and west of Kang-neung chiastolite and mica are produced in clayslate. Between Chhyung-juu and Yön-phung clayslate becomes hard and dark grey and andalusite is produced in limestone. Clayslate in the environs of Cheung-yak, west of Ok-chhyön, contains abundant mica.

Small detached areas in Ham-gyöng-do, that is, in the environs of Kap-san, the west of Yöng-heung and Uön-san, consist mainly of the alternation of clayslate and sandstone, intercalating quartzite, limestone and marl. By the intrusion of granite, clayslate and limestone have suffered contact-metamorphism, the former becoming schistose with abundant mica produced and the latter crystalline with andalusite and other contact minerals. The strike is N.—S. in the environs of Kap-san and N.E.—S.W. in the west of Yöng-heung and Uön-san. The strata are much disturbed and have a complex geological structure.

The many scattered patches in the north of North Phyöng-an-do consist of quartzite, clayslate, schalstein and limestone, deposited in the basin of the gneiss.

The Formation extending from Man-pho-chin of Kang-gyöi to Cha-syöng occupies rather a wide area. The limestone with intercalation of coral and wormy limestone constitutes the region between Man-pho-chin and Hoa-dong, and schalstein with clayslate forms the northern part of the region given above. The strike is E.N.E.—W.S.W. and the dip S.S.E.

Small patches on the tops of the mountains between Hu-chhyang and Cha-syöng consist of dark-green schalstein.

Between Hu-chhyang and Kang-gyöi the rocks are schalstein, clayslate and limestone, the latter being developed mainly in the

south. The intrusion of granite caused a metamorphism in limestone and copper deposits are found along their contact-zone. The strike is N.—S., and the dip is E. or W. in the eastern or the western side of the granite respectively.

In the north of Kang-gyöi the thick beds of limestone dip to the south. In the east and west of the same town, we find sandstone, conglomerate and clayslate, with the strike E.N.E.—W.S.W., forming an anticlinal fold.

In the north of Pyöl-hai-chham, south of Kang-gyöi, we find quartzite, dipping S.S.E. 10° — 30° . In Ib-syök-chham, sandstone and conglomerate alternate with clayslate, running from E.N.E. to W.S.W. and forming an anticline at the middle.

In the area extending southwards from Ui-uön and Chho-san quartzite with thin clayslate forms the lowest horizon and is overlaid by clayslate which accompanies lenticular limestone. Between Ui-uön and Chho-san schalstein and clayslate with limestone overlay clayslate and the uppermost horizon of limestone with clayslate comes on next while in the south of Chho-san limestone directly overlays clayslate. In the former case, limestone is rather thin, but in the latter, limestone with marl forms thick beds. From Ui-uön southwestward to the west of Kal-gol-lyöng, the uppermost horizon of limestone with wormy limestone is developed, the strike being N.N.E.—S.S.W. and forming an anticline and a syncline. In the north of Chho-san and the opposite bank beyond the river, the thick beds of limestone and marl dip gently toward N.E. From the south of Chho-san quartzite and clayslate are found to be developed, until at Hu-chi-dong they are again overlaid by thick limestone and marl. Dr. Gottsche has discovered fossil trilobites at the south of Chho-san. In the environs of Päk-ko-ryöng crops out again wormy limestone with red and granular limestone. A small patch at the south of

the district consists of quartzite and clayslate, dipping W. or N.W. 30°.

In the northeast of Pyök-dong, we see quartzite and limestone which extend further northward into Manchuria, beyond the Am-nok-gang.

Along the Chhyöng-chhyön-gang, south of Yong-pyön and in the environs of An-jyu, quartzite and clayslate with thin beds of limestone dip to north.

Along the western coast of Hoang-hai-do limestone and marl of the upper horizon is found, but the Myör-ak-san Range in the south of Chyang-yön is composed of quartzite and clayslate. The strike is here E.N.E.—W.S.W.

Near Mun-gyöng in North Kyöng-syang-do alternating strata of sandstone, conglomerate and schalstein with thin beds of limestone are found. They overlay gneiss unconformably and dip to N.N.W. 50°. Limestone is grey or greyish black in color and some contain indeterminable fossil remains which are small, elliptical or globular. Clayslate near gneiss often passes into phyllite.

From the facts above stated we may conclude that the Formation consists of quartzite in the lower part, clayslate and sandstone in the middle, and limestone and marl in the upper. In each areas above mentioned, the whole of the complex seems not to have been developed, sometimes only one or two horizons being found.

4. *Fusulina Limestone.*

The low plateau which stretches from the east of Phyöng-yang southwestward to the south, fringing the margins around the mountains of eastern South Phyöng-an-do and Hoang-hai-do, which is composed of the Korean Formation, consists in the main of thick beds of limestone with clayslate, the latter being observed southwards from Chyung-hoa. Limestone is black or dark grey in color

but is generally colored by red or brown clay resulting from decomposition of the same, consequently any good exposure is rare. It often contains *Fusulina*, and that found at Ma-tal-san, west of Sam-deung, is especially rich in *Fusulina*, together with *Gastropoda*. The following fossils were collected by Messrs. T. Iki and N. Fukuchi and determined by Mr. N. Yabe :

At Kai-ka-dong on the southern side of Mu-ro-san, east of Phyöng-yang, beyond Tai-dong-gang :

Fusulina sp. indet. aff. *Richthofeni*, Schwager.

At Ko-pan-san, the east of Phyöng-yang, on the southern bank of Tai-dong-gang :

Fusulina sp. indet. aff. *Richthofeni*, Schwager.

Stacheia.

Bigennerina Bradyi Möller sp.

Lagena sp.

At Ma-tal-san :—Numerous minute shells of *Foraminifera*, some of which probably belong to the young of *Fusulina*.

Mr. Yabe considers the fossil-bearing strata to be referable to the Anthracolitic.

The strike is not often distinct. In the southern part or the environs of Chyung-hoa, the dip is S. W. 30° — 45° ; on the way between Phyöng-yang and Sam-deung the strike is E.—W. or W. N.W.—E. S. E. dipping N. and S. and in the northern part, as Uöl-pha, the dip is S. E. 20° — 40° .

As to its relation with coal-bearing strata the observations of our geologists does not come into agreement, but from the palæontological evidence it is possible to suppose the existence of an unconformability between them.

III. MESOZOIC. (JURASSIC)

The Mesozoic occupies a wide area in Kyöng-syang-do and rather small detached areas over the whole peninsula.

In Kyöng-syang-do the stratigraphical order of rocks, from the upper to the lower, is as follows :

Clayslate formation.

Upper schalstein formation.

Upper sandstone and clayslate formation.

Lower schalstein formation.

Lower sandstone and clayslate formation.

The lower sandstone and clayslate formation of the lowest horizon occupies the western part of the Mesozoic and overlays gneiss unconformably. The mountains composed of gneiss are often rounded and covered by red or brown soil, while those of the Formation are subjected to the characteristic erosion, forming dip-slope near their tops and covered by dark soil. Consequently the boundary between the two is quite distinct, the unconformability being easily recognised from a distance, especially near In-dong and Tan-syöng. The rocks are sandstone, conglomerate and clayslate. In the environs of Syöng-jyu and Tan-syöng sandstone and conglomerate form a thick deposit, intercalating thin clayslate. At Ka-chhi, north of Hyöp-chhyön and at Hoang-chhi, west of Kon-yang, sandstone alternates with clayslate, but the former seems to be more thick. Generally speaking, sandstone and conglomerate lie directly upon gneiss and always form much thicker beds than clayslate. Clayslate in the lower part is sometimes carbonaceous and carries plant fossils. Mr. Yabe has discovered and determined the following fossils near Nak-tong :

Dictyozamites falcatus (Morris).

Nilssonia orientalis Hr.

Nilssonia sp.

Dioonites (?) sp.

Ctenophyllum (?) sp.

Podzamites Reini Geyler.

P. lanceolatus (Lindle & Hutton).

Pinus sp.

Onychiopsis elongata (Geyler).

Coniopteris Herianus (Yokoyama).

C. hymenophylloides (Brongn). (?)

Cladophlebis cfr. *denticulata* (Brongn).

C. Koraiensis Yabe.

C. cfr. *Dunkeri* (Schimper).

C. sp.

Sphenopteris nakdongensis Yabe.

S. sp

Adiantites Sewardi Yabe.

Sagenopteris bilobata Yabe.

Equisetum ushimarens Yok.

The plant fossils which I have discovered in the southern foot of Ka-chhi is of one species :

Onychiopsis elongata (Geyler).

From these palaeontological data Mr. N. Yabe has concluded the plant-bearing strata to belong to the Jurassic.

The upper part of the Formation alternates with thin schalstein and gradually passes to the lower schalstein formation. The lower schalstein formation is mainly composed of schalstein with thin layers of sandstone and clayslate. Schalstein is generally violet, sometimes green or variegated and forms a low and narrow hilly tract in middle Kyōng-syang-do, the region trending from Chin-jyu

northward to the east of Ko-syöng through Hyöp-chhyön and Chhogyöi.

The upper sandstone and clayslate formation has no peculiarities, when compared with the lower, but in general clayslate is much more thick than sandstone, though the total thickness of the deposits is much less than the lower sandstone and clayslate formation. It passes directly to the upper schalstein.

The upper schalstein formation has also no peculiarities which distinguish it from the lower. The Formation extends from Pansyöng, east of Chin-jyu, northward to Chhyang-nyöng and Tai-ku and then northeastward to Sil-lyöng and Eui-heung and together with the foregoing lower schalstein, and upper sandstone and clayslate formation, forms a low and hilly landscape in middle Kyöng-syang-do.

The lower schalstein formation does not occur in thick beds especially in the northern part, so that the upper schalstein formation often overlies directly the thick deposits of sandstone and clayslate or it becomes gradually thin in the north, making no conspicuous deposit.

The uppermost clayslate formation is a thick deposit of clayslate with thin layers of sandstone, and forms a part of the Tai-päik-san Range. The strata which forms the steep and rugged mountains in Kim-hai, Chhil-uön and Yöng-san, is disturbed by great eruptions of granite and porphyrite, and reappears in Kyöng-jyu and Yöng-chhyön. Its boundary with the lower schalstein formation may be traced, as the topographic features of both formations are somewhat different. It begins from the mountains between Chhyöng-ha and Heung-hai and passes westward to Yöng-chhyön and Sil-lyöng. It then turns southward and runs from the west of Hyön-phung through the west of Chhyang-nyöng and Kun-peuk, east of Pansyöng, to the west of Ko-syöng.

In the north of Kyöng-syang-do schalstein is developed, alternating with clayslate and sandstone. On the road between Yöngyang and Chin-po two thin beds of marly limestone are found.

It is noteworthy that clayslate in the uppermost horizon, especially that in the environs of Chhyang-uön, is black or green, hard and compact, sometimes siliceous or hornstone-like, and seems to be much more metamorphosed than that lying below, which is often loose and shaly. This fact is perhaps due to the contact-metamorphisms of granite, porphyry and porphyrite, which occur very often through the Formation.

As the Mesozoic is not much disturbed, the structure is rather simple. The general strike is N.N.E.—S.S.W. or N.—S. The dip is quite gentle with general angles of 8° — 20° toward the east. It is sometimes subjected to foldings or dislocations. But in the north we often observe the strike E.—W. or E.N.E.—W.S.W., the dip being toward the S.

Dykes and sheets of porphyry and porphyrite, besides large eruptions of granite, porphyry and porphyrite, are very frequent. The rocks are often subjected to contact-metamorphism, thereby the sandstone and clayslate in the east of Ha-tong and the clayslate in Syang-gyöi have eventually become fine and hard, and some are found to contain mica, being due to the contact-action of porphyry on the sandstone and of granite on the clayslate.

The strata extending from northeast to southwest in the middle part of Chyöl-la-do, are deposited in the basin of the gneiss region, and consists of sandstone, conglomerate, clayslate and schalstein, intruded by many dykes and sheets of porphyry and porphyrite. Generally sandstone and conglomerate form much thicker deposits than the others. Near Keum-san-dong between Syun-chhyang and Keum-gu sandstone and conglomerate alternate with black

and green clayslate and dip generally south. In the west of Chin-an conglomerate, chiefly composed of the pebbles of gneiss, clayslate, quartz, gives rise to a curious forms of erosion. The famous Mo-ak-san with two peculiar rounded peaks, composed of conglomerate, stands solitary to the southwest of Chin-an and is to be recognised from a distance. In the neighborhood of Tai-phyöng, 2 ri west of Chin-an, conglomerate passes into sandstone, and interstratifies with clayslate. Here it strikes from N.E. to S.W., dipping S.E. in the eastern part and N.W. in the western, thus forming a syncline.

A small area in the south of Mu-jyu consists mainly of conglomerate with sandstone and clayslate, directly lying on gneiss. The conglomerate in Peuk-chhang, south of Mu-jyu, is characterised by containing large pebbles of porphyry, often one meter in diameter, the strike being almost E.—W.

In the east of Hoa-syun, the alternating strata of sandstone, clayslate and schalstein gently dip to the E. Near the Phyllite Formation in the east, the rocks are much metamorphosed and becomes schistose.

Along the Keum-gang near Kun-san, sandstone and clayslate run from E.N.E. to W.S.W. On the opposite bank of Syö-pho, northeast of Kun-san, stands a solitary hill, consisting of clayslate with thin sandstone and coal seams. In the northwest of Ham-yöl clayslate overlies unconformably the Kun-san Formation and dips to N.W.

The area which extends to the north and south from Yöng-dong and Hoang-gan is composed of the alternation of sandstone, conglomerate and clayslate, with thin beds of schalstein in the lower horizon and of thick ones in the upper. The strike is $N.60^{\circ}-70^{\circ}E$ in the environs of Hoang-gan, forming a syncline near the town, but in Yöng-dong the strike turns to $N.20^{\circ}-30^{\circ}W$, and gently dips toward E.N.E.

The strata stretching from Chhyung-yang southwards are composed of dark grey siliceous sandstone and clayslate, the former often passing into conglomerate.

The mountains along Keum-gang, west of Koang-jyu, consists of sandstone, conglomerate and schalstein, dipping W. 10° — 20° . The hilly tract along Yöi-syöng-gang, from Nam-chhyön-työm, $1\frac{1}{2}$ ri N. of Phyöng-san, to Kai-syöng, through Phyöng-san and Keum-chhyön and still further southwards to Thong-sin and Kang-hoa, consists of sandstone, conglomerate, schalstein and shale, the former two representing the lower horizon and the latter the upper. Thin layers of marly limestone are sometimes seen interbedded in them, as at Phil-tong of Phyöng-san. In the southern part, including Hoang-hoa, Thong-sin, sandstone and conglomerate with thin shale seem to be much developed. The strike is generally W.N.W.—E.S.E. and the dip is S.S.W. 20° , but in the south, the dip changes to N.E. and in Hoang-hoa Island a small syncline is noticed.

The hilly region which stretches from Phyöng-yang southwards along the Tai-dong-gang, is composed of shale and sandstone in the lower part and of shale, sandstone, conglomerate and schalstein in the upper.

The strata developed in the environs of Phyöng-yang and between Phyöng-yang and Sam-deüng, represent the lower part, generally consisting of the thick deposit of shale, overlaid by sandstone. Many coal seams are interbedded in the strata. Shale in Kam-peuk-uön, about 1 ri north of Phyöng-yang, contains fossil flora. The following two species have been determined by Prof. M. Yokoyama :

Podozamites lanceolatus.

Todites Williamsons.

From these forms, he has concluded the fossil-bearing strata to be-

long to the Jurassic. The strike is E.N.E.—W.S.W., generally dipping southward. The remaining hilly tract represents mostly the upper part and is composed of sandstone and conglomerate with thin layers of shale. The rocks are tufaceous, often passing to schalstein which sometimes attains great thickness. The strike of the strata is generally N.E.—S.W. and the dip is S.E. 30° — 40° in the northern tract while in the southern the strike turns nearly N.—S. At the opposite bank of Chin-nam-pho the dip is N.E. 8° — 20° and on the road between Chyang-nyöng and Pong-san it is nearly N. 60° — 80° .

The hilly land extending from north to south, between the lower Tai-yong-gang and the lower Chhyöng-chhyön-gang, consists of sandstone, conglomerate and clayslate with subordinate layers of schalstein. The dip is generally S.E. 10° in the northern part and E. 30° — 40° in the southern, showing the existence of a fault between them.

Near the northern frontier of Ham-gyöng-do, we find along the Tu-man-gang the alternation of sandstone and clayslate with conglomerate. The rocks, except those found in a small area near Hoi-ryöng composed of sandstone and clayslate, are often much metamorphosed. The strike is generally N.—S. in the environs of Hoi-ryöng, N.E.—S.W. in the environs of Chyong-syöng, and at N.W.—S.E. in the northern half Ko-kön-uön and N.E.—S.W. in the southern.

All the formations above referred to are not yet fully studied and can not be compared in any way, either stratigraphically or palaeontologically with those in Kyöng-syang-do and Phyöng-yang, but from their petrographical character, so far as my observations go, it is highly probable that the Formations are identical with those found in Manchuria, Phyöng-yang and Kyöng-sayng do.

In the west of Mok-pho, sandstone alternates with clayslate and

dips to E.S.E. 8°. The complex probably belongs to the Mesozoic, although the rock characters make it seem much younger.

IV. TERTIARY.

The Tertiary is found in a few small areas scattered in Ham-gyöng-do and Kyöng-syang-do, along the Tu-man-gang and the Sea of Japan. It has been deposited in the basins or depressions of the gneiss, Palæozoic, Mesozoic or granite region.

The Tertiary in Ham-gyöng-do—The rocks are of alternation of loose shale, sandstone and conglomerate, with interbedded coal seams. They are often overlapped by the basalt flow.

The Tertiary in Kyöng-syang-do—The rocks are grey or yellowish grey tuff, sandstone, conglomerate and shale, with several coal seams. The shale and tuff between Heung-hai and Chyang-gi contain fossil flora, such as : *Sequoia*, *Acer*, *Sterculia*, *Podogonium*, *Phragmites*, *Salix*, *Quercus*, *Carpinus*, *Ficus*, *Juglans*, *Fagus*, *Planera*, *Populus*, *Rhamus*, *Sapindiphyllum*, etc., The strata are undulatory, the dip being mostly less than 10°.

The strata found in small detached areas described below will perhaps belong to the Tertiary :—in the west of Naing-syu-työm on the road between Kim-hai and Chhyang-uön, the alternating strata of green, violet or greenish-grey tuff, shale and conglomerate dip to S.S.W.; in the east of Koang-yang and Syun-chhyön, violet or yellow tuff alternates with sandstone and conglomerate, and in the Yöng-am peninsula and in the north of Mok-pho, we see green tuff and shale lying on porphyry.

V. QUATERNARY.

The loose deposit of the Quaternary is divided into two: diluvium and alluvium.

1. *Diluvium.*

Diluvium occupies only the narrow and small areas along the mountain foot or the rivers. Those found in the northwest of Thong-chhön, in the north of Uön-phöng, S. of Keum-gu, in the east of Chang-heung, in the south of Chin-po and in the south of Ön-yang, are rather important. They constitute terraces or flat lands of small areas, composed of clay, sand and pebble.

2. *Alluvium.*

The alluvium is of two kinds. The one belongs to the littoral deposits along the sea coast or near the mouth of rivers, generally composed of fine sand and clay, and the other belongs to the fluvial deposits among the hilly and mountainous tracts, consisting of sand and pebbles covered by clay. Almost all the placer gold in Korea occur in the fluvial deposits.

VI. GRANITE.

Granite is the most widely extended of all other eruptives and comes next to gneiss in its distribution. It is generally coarse-grained and is easily susceptible to decomposition. Granite and hornblende granite are very common varieties, together with muscovite granite. Their characters greatly differ with the various localities. In Mol-un-chhi between Phöng-chhyang and Kang-neung, augite bearing granite is found. Granite is sometimes dioritic or syenitic and often passes into granite porphyry, their distinction being frequently difficult.

Granite eruption seems to have continued from the Archæan to the Mesozoic Era. On one side, granite affords contact-metamorphism to the rocks of the surrounding Palæozoic and the Mesozoic, while on the other it attains schistose structure, so that we can hardly distinguish it from granite gneiss.

VII. PORPHYRY.

Porphyry occupies a few but tolerably large areas in Tai-po-san and its environs, W. of Phöng-yang, in Yöng-am and Mu-an peninsula, and in the northeast of Mun-gyöng. It also intrudes the gneiss, Palæozoic, Mesozoic and granite as dykes and sheets, which are especially abundant in South Chyöl-la-do and South Kyöng-syang-do, so that they can not be fully shown in the annexed geological map.

Rocks are of various kinds. Quartz porphyry, containing porphyritic quartz and often felspar and biotite on the dark grey or light violet ground mass, is very common. The rocks occurring as dykes or sheets, generally belong to this kind. The mountain, E. of Chin-san and the steep mountain at the north of Mu-jyu, consist of quartz porphyry, and Tai-po-san of granite porphyry. At Mong-tong-ni, E. of Mok-pho, quartz porphyry contains large bipyramidal crystals of quartz and red and white felspar, sometimes having a granitoid aspect. In the east of Mun-gyöng, the boundary between granite porphyry and granite is not distinct. Thus the sharp boundary between quartz porphyry, granite porphyry and granite is often not perceptible. Porphyry found in somewhat large area is often brecciated. The rocks of this kind are light-brown, light-green or grey and some which contain numerous breccias, resemble tuff breccia. They are often subjected to peculiar erosion, giving rise to a steep and rugged landscape, as in the east of Hai-nam, and No-ryöng, N.E. of Nam-phyöng. On the eastern coast, between Yong-dök and Chhang-ha and in the environs of Sya-chhang-jyang, porphyry of this kind is found. In the environs of Hong-uön, quartz porphyry resembles liparite, intrudes granite and overlaps it. Porphyry, in the south of Ma-san-pho is platy and contains hornblende and felspar but is destitute of quartz, being more trachytic.

VIII. PORPHYRITE.

Porphyrite occupies somewhat wide mountain districts in the southern and middle part of Chyöl-la-do and the southeastern part of Kyöng-syang-do. Besides, abundant dykes and sheets especially in the southern part, are found intruding the gneiss, Palæozoic, Mesozoic and granite. The rocks are generally composed of grey-green or deep-green ground mass with porphyritic crystals of plagioclase, but we may distinguish hornblende porphyrite, augite porphyrite and biotite porphyrite. Some of them contain quartz and the decomposed varieties are sometimes not distinguishable from porphyry. Porphyrite in the wide areas, is often brecciated, with the fragments of clayslate, tuff, porphyry and porphyrite, thus resembling tuff breccia. It is generally light-brown, green or deep green in color. From this fact we may suggest with some certainty that eruptions of porphyrite have taken place several times and some may have erupted later than the porphyry. The mountains composed of porphyrite are generally high and precipitous and afford a peculiar land form, as already stated.

IX. ANDESITE AND ITS AGGLOMERATE.

Andesite and its agglomerate occupy only a few small areas, besides as dykes, near the eastern coast and also constitute Chyöi-jyu-do or Quelpart Island. Hornblende andesite between On-syöng and Kyöng-uön bears porphyritic crystals of plagioclase, hornblende and biotite in a light-grey ground mass and overlays granite. Andesite scattered between Chyang-gi and Kyöng-jyu intrudes the Mesozoic and Tertiary. It is of two kinds, the one being hornblende andesite, with hornblende and plagioclase in a dark-grey or black ground mass, and the other hornblende-biotite ande-

site, bearing porphyritic crystals of hornblende, biotite and plagioclase. Augite andesite is found as dykes near the eastern coast of Chyang-gi and also in Ha-syö and Ho-am between Chyang gi and Ul-san, and is dark-green in color. It sometimes assumes beautiful columnar joints and accompanies agglomerate.

Chyöi-jyu-do is a volcanic island, in the middle of which there stands the high and majestic cone of Hal-la-san (2040 m.) with a crater lake about 1 ri in circumference on its top. The rocks are grey porous pyroxene andesite.

X. BASALT.

Basalt terrain always forms lava plateau. Basalt plateau in the northern Ham-gyöng-do is broad and high, reaching a height of 1400--2000 meters. The valleys through the plateau are narrow and cñon-like, forming rapids and foaming cascades. Basalt flow covers the broad plain of Syu-an, Kok-san and Sin-gyöi, and proceeds into the valleys close by. Its thickness is estimated to be 220--230 feet. The hills seen scattered in the plateau are the islands of the Palæozoic in the basalt sea. In the environs of Phyöng-gang and Thyöl-uön, basalt overlapping granite, forms a plateau along the mountain foot as well as both banks of the river. Basalt is generally grey or dark-grey, and of various kinds, being crystalline as dolerite or anamesite, or microcrystalline, as ordinary basalt or glassy as obsidian. Generally, the lower parts of the flow are somewhat compact, while the upper porous. Plagioclase and olivine are the chief constituents of basalt, in which pyroxene is less predominant. Dykes in Syu-an gold mine have intruded granite and caught up its blocks. They are black and compact, with a few olivine and abundant pyroxene, beside plagioclase. Basalt in upper Un-chhyang-gang north of Kap-san and in Kil-jyu accompanies its tuff and agglomerate. Basalt overflowed upon

phyllite along Im-jin-gang and along the coast of Thong-chhyön is beautifully columnar, affording a picturesque scenery to the land.

CHAPTER IV. MINERAL RESOURCES.

Korea yields gold, silver, lead, copper, iron, graphite and coal. Among the mineral resources, gold and copper only are of importance, the production of iron and coal being insignificant.

Gold.—Almost all of the gold obtained in Hoang-hai-do, Kyöng-geui-do, Chhyung-chhyöng-do, Kang-uön-do and Chyöl-la-do is brought in Seoul and is there purchased by the Seoul branch-office of the Dai-ichi-gin-kō Bank. The amount is estimated to be 1,600,000–2,000,000 yen (about £160,000–200,000) annually. From Gen-san (Uön-san) gold, 1,000,000–1,300,000 yen in value, is annually exported, forty to fifty per cent of which is probably produced in Ham-gyöng-do, and the remaining fifty to sixty per cent imported from Siberia. Gold purchased by the Phyöng-yang branch-office of the Dai-ichi-ginko is valued at more than 1,000,000 yen per annum, the greater part of it belonging to the placers from Syun-an. Gold produced in Kyöng-syang-do concentrates in Fu-san, whence it is exported, the annual amount scarcely exceeding 100,000 yen in value. From these facts we can estimate with some certainty that the total annual production of gold in Korea will exceed 3,000,000 yen, excluding the gold from the mines under the management of foreigners. Two-thirds of the total production of gold is obtained from placer gold.

Copper.—The only copper mine worked is the Kap-san Mine, its annual production being roughly estimated to be 300,000–500,000 kin.

1. Japanese measure of weight. 1 kin = 560 grams.

I. GOLD MINES.

Gold deposit may be divided into two classes, the metalliferous veins and metasomatic deposits.

1. Metalliferous veins. The thickness of veins varies greatly, from an inch to 6 feet or more. They usually consist of white or grey-white, compact quartz, with pyrites, and other sulphide minerals, scattered in it. When quartz contains much sulphide minerals and is rich in fissures and cavities or is loose through carrying brown clay or limonite in fissures and cavities, its gold content is generally high, while hard and compact quartz seems to be destitute of gold; hence in spite of the wide veins the extent of payable area is comparatively small. It is reported that the quartz veins of the gold mine of Un-san contain much sulphide minerals which are sometimes banded with quartz and are consequently rich in gold, but those in the other mines, as Chǎ-mo-san, Chik-san, etc., contain less sulphide minerals, and gold chiefly occurs in fissures and cavities. The available ores will perhaps be due to the secondary enrichment after the deposition of the hard quartz veins. Sometimes cracks in gneiss and granite, 0.1-0.4 inch thick, are found to be filled with sand and clay of black or dark-brown color. This sand and clay yield gold, and are now worked in Sai-mok of Syōng-ju. The gold is deposited apparently secondarily with sand and clay.

2. Metasomatic deposit.—The deposit occurs in the Palæozoic limestone, being formed by its replacement with ores, near the contact with granite. The ores are limestone charged with sulphide minerals, which are impregnated in the rock, along its stratification plane or filled in fissures, as large irregular masses. The gold content of the ore is considered to be almost proportional to the amount of sulphide minerals. Gold mines of Ap-eun-san and Syu-an belong to this class.

Valleys and rivers in the neighborhood of the gold mines generally yield placer gold and for the sake of convenience such placer fields will be described in sequel together with the gold mines.

UN-SAN MINES.

The concession consists of the gold mines in Un-san County and is now worked under the control of Americans in five places; that is, Tai-bahoi, Tari-kol, Keuk-syöng-dong, Chin-balbi and Eung-pong. The head-office of the mining firm is situated at Peuk-chin, about 9 ri north of Un-san. Tai-bahoi is about $1\frac{1}{2}$ miles north of Peuk-chin and Tari-kol, only half a mile. Keuk-syöng-dong is situated about 8 ri, E.N.E. of the head office and Chin-balbi about 8 ri south. Eung-pong lies about 1 ri W.S.W. of Chin-balbi.

The date of the discovery is not recorded, but it is said that the mine had already been worked in the dynasty of Ko-ryö or Korea. About ten years ago, Americans obtained the concession and have carried on their works under the name of the Oriental Consolidated Mining Company.

The production of gold is not distinct, the probable estimate being as follows:

	Tai-bahoi	Tari-kol	Keuk-syöng-dong	Chin-balbi	Eung-pong	Total
	Tons	T.	T.	T.	T.	T.
Ores.	4,500— 5,000	9,000— 10,000	5,000	1,500— 2,000	4,000	24,500— 26,000
	Momme (1)	Mo.	Mo.	Mo.	Mo.	Mo.
Gold, extracted.	8,500— 9,000	18,000	6,000— 6,500	2,500	4,000	39,000— 40,000

Tai-bahoi and Tari-kol.—Among numerous veins in gneiss only one important vein is now worked by shafts. At Tai-bahoi, the vein is in general 12—15 feet thick, striking N. 80° E., and dipping N. 72° and has been traced for about 2000 feet on the strike. The vein is split up into two at a spot about 400 feet east of the shaft.

(1) Japanese measure of weight. 1 momme = 3.75 grams.

with the parting about 20 feet thick, but reunites thence about 500—600 feet eastwards. The thickness there varies from 1 to 10 feet, accompanying a few parallel veins 1—2 feet thick. In the west of the shaft the vein is thin and is not workable. The depth of the shaft now reached is 520 ft. and the largest level is 1400 feet long.

In Tari-kol, the vein runs from E.N.E. to W.S.W. and is traceable for about 6000 ft along its outcrops. It is separated into two at about 700 ft. west of the shaft, the parting gradually widening to the west. The vein has a thickness, varying from 1 to 10 ft. and sometimes accompanies a few minor veins of 1—2 feet thick, in the parting. At about 20 ft. west of the shaft, the vein in the fourth level is cut by a fault dipping W. 70° . In the eastern side of the fault, a vein 1 ft. thick dips steeply to the N.W. The shaft is now 630 ft. deep and the length of the longest level is 2000 ft. The distance of these two shafts in Tai-bahoi and Tari-kol is about 4000 ft. The veins worked separately in two places will indeed be one and the same, the distance being due to the dislocation running from north to south.

The other veins run almost parallel to the main vein given above, and only one of them is now worked by a few miners.

Keuk-syöng-dong.—A vein occurs in gneiss and is cut by a fault running from N.W. to S.E. In the southwestern side of the fault the vein strikes N. 20° E. with a gentle dip W.S.W. 12° . To S.E. the vein is cut by a pegmatite dyke, running from N.E. to S.W., beyond which we can not yet discover the same, and hence the extension is estimated to be only 800 feet. In the northeastern side of the fault the strike of the vein is N.E. and the dip N.W. 13° . The thickness of the vein is generally 14—15 ft. In the neighborhood we find a few veins, one of which seems to be the continuation of the main one.

Chin-balbi.—The vein now worked crops out on the top of the mountain in the east of the village. It has a strike of N. 17° W.—S. 17° E. and a dip of W. 72°, extending about 1300 ft. on the strike. The thickness of the vein is 3—6 feet near the outcrop, widens 10—15 feet at 200—250 ft. below the shaft, and as it gets deeper it gradually becomes thin. At about 360 feet below the shaft the vein is 1½ feet thick but at 460 ft. below the depth it begins thinning away. Almost all parts of the vein were already worked out. A few other veins in the neighborhood run almost parallel to the main one and have been worked.

Eung-pong.—One worked vein has a thickness of 6 ft. near the outcrop but branches into two below the surface with a parting of 60 ft. The dip is W. 35° near the outcrop and becomes steeper below, attaining 60° in the third level. The vein has a thickness of 4—5 ft. and sometimes 12 ft. above the third level, but it becomes gradually thinner as it increases in depth. The eastern branch of the vein has a thickness of 4 ft. in the fourth level and 0.5 ft. in the fifth and the western branch splits into thinner and smaller veins below the third level. The workable length is estimated to be about 1000 ft. Two veins are found to the east of the main one.

Ores are of white or grey, hard and compact quartz, carrying sulphide minerals, as iron pyrites, galena, zinc-blende etc., iron pyrites being generally most abundant. The vein in the north-eastern side of the fault of Keuk-syöng-dong contains much arsenopyrite and galena, instead of iron pyrites. These minerals are often found filling the fissures and cavities of veins and form banded structures with quartz. Gold is considered to be contained in these minerals or in loose portions of quartz, rich in fissures and cavities. The gold content of the ores is variable but not poor, yielding in average 0.001% of gold.

CHǎ-MO-SAN MINE. (Plate II.)

The mine is located at the southwestern foot of the famous fortification of Chǎ-mo-san-syōng and is only 2 ri distant from Am-chyōk-ri station.

The district is composed of granite-gneiss of coarse-grained as well as of fine-grained. The strike of the gneiss is almost N.—S. in the northern part and N. 15°—20° E. in the southern, and the general dip is E. 40°—50°. Twelve or thirteen principal veins, with the exception of one or two, are imbedded in the plane of schistosity of gneiss. Among these veins four are most important. The strike of the veins is N.—S. sometimes from N.N.E. to S.S.W., dipping E. 50°—70°. The thickness of the veins varies from 0.2 ft. to 3 ft. and the principal ones are generally 1—2 ft. thick, extending 100—300 m. on their strike. Ores are of white or greyish-white, hard and compact quartz, bearing sulphide minerals— as pyrites galena, zinc-blende, etc., in its fissures and cavities. Gold is considered to be contained in those portions, carrying sulphide minerals, or where it becomes loose, rich in fissures and cavities and accompanies limonite and clay. So even in the case of large veins the portions treated as ores are small quantity. Generally ores are rich near the outcrops and were almost worked out.

The following is the result of the chemical analysis of ores :

	1. Loose, ore brown	2. Grey white quartz with limestone in fissures etc.	3. Like(2)	4. Average	5.
Gold	0.0007 %	0.0016 %	0.0006 %	0.0004 %	0.0006 %
Silver	—	0.0004 %	—	—	0.0022 %

CHIK-SAN MINE. (Plate III.)

The head-office of the mine is situated at Po-tōk-uōn, about 3½ ri, S.E. of Syōng-hoan station. The mining district embraces

an area within 1 or $1\frac{1}{2}$ ri around Yu-jyang, about $\frac{5}{8}$ ri N.W. of the office.

The production of gold is not quite certain but the tax raised from April to September in 1905 amounts to 1,840 momme in gold. The output of gold under the direct control of the company is 1,193 momme for the same period.

The mine has long been worked under the direct control of the Imperial House of Korea. In 1900 it was transferred to the hands of the Shibusawa and Asano company, under whose management the working was actively operated for a few years. After struggling against several difficulties, the company has stopped a greater part of its operations and at present is working a few placer fields under its direct management.

The mountainous part of the district consist of gneiss, while the hilly tract around the foot of the mountains is composed of biotite or muscovite granite. Broad and fertile plains and valleys are found among the mountains and hills.

Auriferous Veins.—Numerous quartz veins traverse gneiss and sometimes granite. Four principal veins run from N.E. or E.N.E. to S.W. or W.S.W. parallel to the schistosity of gneiss, dipping N.W. or S.E. 70° – 80° . The thickness of the veins is generally 1–3 ft. but sometimes it reaches 9 ft. or thins away to a few inches. It sometimes extends over 3600 ft. on the strike. Ores are white or grey, hard and compact quartz, with disseminated pyrites. They are partly loose, rich in fissures and cavities, and are stained by iron oxides and clay. The hard and compact portions do not yield gold, and the loose portions or those with pyrites, which are in small quantity, are only workable. Ores near the outcrops are rich in gold but they have almost been worked out.

Placer gold.—Placer gold is found everywhere in the rivers of

the district and is of fluvial and eluvial deposits the latter being found only in one place. The payable bed for placer gold consists of granite sand with pebbles and lies generally at a depth of 15–20 ft below the surface. The thickness of the bed varies from a few inches to $3\frac{1}{2}$ feet and is 1–2 ft. in general.

The placer field was already in work about 10 years back and the operations were developed extremely 4–5 years ago. At present about 350 men are engaging in the operation. The total extent of the field is more than 4 ri and there remains a considerable area which deserves farther prospecting.

KEUM-GU MINING DISTRICT. (Plate IV.)

This mining district embraces an area of $1\frac{1}{2}$ ri around Ku-ryong-san, which rises E.S.E. of Keum-gu.

The date of discovery is not recorded. It was reopened about 18 years ago and worked under the control of the Imperial House of Korea. At present, 700–800 men are actively engaged in the workings, the total output of gold being about 12,000 momme monthly.

The district is composed of granite-gneiss, sometimes with quartz-schist and augite-schist and intruded by quartz-porphry. Gneiss is often very loose from decomposition, especially in the hilly tract on the western flank of Ku-ryong-san. Small gold flecks are often found in the decomposed gneiss when washed. Gneiss strikes generally N.N.E.—S.S.W. with steep inclination to W.N.W or E.S.E. 60° – 70° . The plateaux on the western foot of the mountain and terraces at the north of Uön-phyöng, besides small ones along the rivers, represent diluvium and consist of clay in the upper part, and sand and pebble layers in the lower, covering gneiss unconformably. Wide plains and valleys are also found there.

The district is conveniently divided into two areas, the eastern

and the southern mining districts. In the former district, gold ore is chiefly worked and the latter yields mainly placer gold.

The eastern mining district embraces an area in the east of Keum-gu or the east and south of Ku-ryong-san and is now worked by many decads of miners in the vicinity of Yang-syök-dong and Pong-nim-dong.

Numerous veins, more than 20, traverse gneiss, sometimes quartz-porphyry or contact zone between these two rocks. The strike of the veins is N.N.E. or N. parallel to the schistosity of gneiss, often cut by a number of veins running from E. to W. The inclination is very steep or almost vertical. The veins are all thin, the thickness varying from 2 to 6 inches. They sometimes attain a thickness of one foot but within a short distance thin away to the mere cracks. Ores are quartz with scattered pyrites and associating clay, limonite or mother rocks. An abandoned vein in the hill of the south of Yang-syök-dong seems to be fissures in gneiss filled up with quartz, sand and clay together with gold.

The placer fields in the district are limited and not worthy of special notice.

The southern mining district.—Gold ore is worked only in two places by a decad of miners. A vein found about $\frac{1}{6}$ ri E. of Keum-san-sä, is imbedded in gneiss with the strike N. 20° E. and a steep dip to the W. The thickness of the vein is 2 feet at most. Good ores consist of quartz, mother rock and clay, containing abundant pyrites, galena, chalcopyrites, etc., the sulphide minerals forming often the banded structure with the gangue. The result of the chemical analyses of the ores is as follows :

	Gold	Silver	Lead
1.	0.0010 %	0.0096 %	6.72 %
2.	0.0064	0.0142	1.59

Numerous veins in the northern part of Ku-ryong-san are generally thin, being 2-3 inches thick, but sometimes widening to 1-2 ft. They run N. 10°-20° E., steeply dipping to E. or W.

Placer gold is of fluvatile and eluvial deposits and is now actively worked. Placer gold in the eluvial deposit is found along the foot of the hills in the western part, the placer field of Yong-pan-ni and of the east of Phyöng-san being now productive. The uppermost consists of brown clay under which lies brownish-white or pale-green sandy clay, sometimes with quartz. It is said that there occur two payable deposits of 0.6-1.2 feet thick at a depth of 14-30 feet. The payable deposits are composed of light-brown or pale-yellowish-green sandy clay, whose content is as follows.

	1.	2.	3.	4.	5.	6.
Gold	0.0154%	0.0004%	0.0002%	—	Trace	0.0002%
Silver	—	—	—	0.0004%	—	0.0003

Placer gold in the fluvatile deposits is extensively worked along the rivers or the drainage areas of the rivers and terraces, especially in the environs of Uön-phyöng, Ko-ya, and Pong-syö-tong. The payable bed is composed of sand and pebbles to a depth of 10-30 feet and is 1-3 ft. thick. The placer field will be still productive in the future and there remains a fairly extensive area to be opened.

AP-EUN-SAN MINE. (Plate V.)

This mine is situated in the village of Yong-hoa-bang (Gwendoline), about 2 ri S.E. of Eun-san, the head-office and mining station being in Yö-yang and metallurgical station in Yang-ti-chhon, connected by aerial wirerope. The transportation by Tai-dong-gang is from Ko-dong, about 4 ri S. of the mine.

The mine was opened many decades ago and for the last forty

years it has been worked under the control of the Imperial House of Korea. The mining rights over an area including about 4 ri E.—W. and 2 ri N.—S., are transferred to an English, who discovered a rich deposit in 1903. Various improvements have since been introduced. The work is carried on at present under the name and style of the British-Korean Coöperation.

In 1904 the mining and metallurgical arrangements were completed, and consequently the production suddenly increased to 14,000–18,000 momme of gold per month from 1800 tons of ores. But at the beginning of 1906 the ores were almost worked out and at last in April of that year the mine has had to submit to the misfortune of being abandoned.

The rocks are alternations of limestone and clayslate. They are often metamorphosed, clayslate passing to phyllite and limestone becoming white and crystalline. So-called white and hard quartzite in the mine is probably a vein cutting the limestone near the shaft. The strike of strata is N.W. or W.N.W.—S.E. or E.S.E., dipping N.E. 20° – 30° .

The deposit occurs in schistose crystalline limestone, replacing it with such sulphide minerals as auriferous pyrrhotite, pyrites, etc. These sulphide minerals are either scattered in limestone or impregnated along the bedding plane, or filling up its fissures and cavities, and form large irregular ore masses. The thickness of the deposit varies greatly, sometimes widening to 70 feet or thinning away rather suddenly. It extends like the mother rock from N.W. to S.E. being traceable for about 300 feet on the strike, but to the dipside it is sigmoidal, that is, the dip being eastward in the upper part, westward in the middle and again eastward in the lower.

Metallurgically the mine is fully equipped, thus allowing of

95 $\frac{1}{2}$ % of gold in the ore being extracted. The gold content is considered to be proportional to the quantity of sulphide minerals and is esteemed generally to be 0.003 %. The gold and silver content of the ores collected is as follows :

	1.	2.	3.	4.
Gold	0.0076 %	0.0146 %	0.0088 %	0.0040 %
Silver	—	0.0050	—	—

SYU-AN MINE. (Plate VI.)

The mine is situated in the village of Hol-kol, about 7 ri N. of Syu-an. The village of U-gang on the bank of the Tai-dong-gang lies about 3 ri E.N.E. of the mine.

The mine was worked several hundreds of years ago but afterward it was abandoned by the order of the government. In 1894 it was reopened and in 1901 the management of the mine was transferred to a Japanese, who introduced some improvements. Since 1903 the mine has been worked under the control of the Imperial House of Korea.

The output of gold is quite indistinct, but from the number of the stamp mills it may be estimated to be about 1,200-1,300 momme per month. Every year from November to April of the next year the water here freezes, and all operations have to be suspended.

The mining district is composed of clayslate, limestone and granite. Clayslate and limestone dip generally N.N.E. 40°-50° and are metamorphosed in contact with granite.

The deposit occurs in limestone near the contact with granite in the south of Hol-kol, the nature and form of the deposit being quite similar to those of the Ap-eun-san Mine. The deposit is very irregular in its distribution but is supposed to extend for about 1000 ft.

along the contact zone of limestone with granite, its breadth varying from a few feet to 140 feet. Ores are limestone, carrying sulphide minerals, as chalcopyrite, pyrite, stibnite and bornite.

Some of the ores are hard and compact, dark-grey or light-green in color, while the others are somewhat loose and white. Generally speaking, the hard varieties are found in depth and contain much bornite; but the loose one is seated near the outcrops and carries chiefly chalcopyrite and pyrite, associated with copper carbonate.

The content of gold is deemed to be proportional to the quantity of metallic minerals, the distribution of which is very irregular.

The following is the result of the chemical analysis of the ores collected :

	1.	2.	3.
Gold	0.0011 %	0.0008 %	0.0005 %
Silver	0.0061	—	—

THE MINOR DEPOSITS AND MINES.

Han-tai-dong (South Ham-gyöng-do).—This mine is situated on the hills, about 1 ri N. of Työng-phyöng. It was opened about 8 years ago and worked for three years. In the year 1905, one vein was discovered and at present a few decads of miners are engaged in working this as well as the others. Two or three veins 0.4-2.0 feet thick traverse granite and dip N.E. 70°. Ores are quartz, containing pyrite, chalcopyrite and galena, sometimes yielding free gold visible to the naked eye. The following is the result of the chemical analysis :

Gold.	0.0042.	Silver.	0.0023
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Neung-dong.—The mine lies on the mountain side, about 5 ri E. of Yöng-heung. The date of discovery is not recorded but the mine was reopened about 20 years ago. At present more than ten miners are occupied in working it. Five or six quartz veins, mixed with the fragments of mother rocks and clay, occur in granite. The thickness of the veins is generally 7–8 inches but sometimes 2 feet. The ores yield generally 0.002–0.003% of gold.

Koang-syöng.—The mine is situated about 3 ri E. of Yöng-heung. In 1904 several veins were discovered and at present they are worked by a score of miners. Five or six quartz veins, 0.5–1.0 foot thick, traverse granite. The ores are of inferior quality.

Syang-koang-dong (North Phyöng-an-do).—The mine is located on a mountain side, about $2\frac{1}{2}$ ri S.E. of Chhyöng-syöng, which lies about 11 ri N.E. of Eui-jyu (Wi-jyu). The mine was opened about 10 years ago and since then for 7 years it had been more or less actively worked, sometimes by more than 500 miners, until 4 years ago when it was abandoned.

Numerous veins traverse here granite-gneiss. The principal veins are 8 in number. Their thickness varies from a few inches to 3 feet, only 3 veins having a thickness of more than 1 foot. The veins are almost parallel to each other from E. to W., dipping N. or S. Ores are hard and compact quartz with sulphide minerals, and are generally of inferior quality in thick veins.

Tong-chhang.—The village of Tong-chhang is situated about 8 ri S.E. of Chhyang-syöng and may be reached within a distance of 4 ri from the head office of the Un-san Mine in Peuk-chin. The mining district embraces an area from Koang-chhyön-ni, about $1\frac{1}{2}$ ri S.E. of Tong-chhang, eastwards to the boundary of the Un-san county, the extension being over 1 ri long. The veins are said to

have been worked since 35 years ago, but at present only one vein is being worked by a score of miners.

Among numerous veins which traverse granite-gneiss, five are important. As the mine was abandoned for a long time, the veins in it are not visible at present, but their strikes seem to lie between E.—W. and N.W.—S.E. and their thickness to vary from 0.4 to 1½ feet. Ores are white or grey, hard compact quartz with sulphide minerals, as galena, pyrrhotite, etc., which are considered to contain gold. The result of the chemical analysis of gold ores is as follows :

1.	Gold.	0.0033.	Silver.	0.0038.
2.	Gold.	0.0058.	Silver.	0.0041.

Syön-chhyön.—This mining district extends from Syu-dong, about ½ ri N. of Syön-chhyön, to Paik-hyön-ni, about 2 ri N. of the same town. The mine was opened about ten years ago, and more than 200 miners were sometimes occupied in the workings, but at present they have decreased to less than 20.

Numerous quartz veins occur in granite-gneiss. Their thickness varies from an inch to a foot, with an average of 5 inches. The veins run almost parallel to each other, having a strike of E.—W. and the dip of N. or S. 70°—80° or vertical. The ores are white, hard and compact quartz with pyrite, etc. Best ores yield 0.0059% of gold and 0.0023% of silver.

Kil-syang-ni.—The mine is located on the mountain sides in the vicinity of Kil-syang-ni, about 7 ri S. of Kui-syang. It was opened about 3 years ago, and the working is more or less governed by climatic conditions, at present about 50 men being at work during winter and 200 during summer.

Numerous veins traverse granite-gneiss. The principal veins,

numbering ten, run almost parallel to each other from N.E. to S.W., excepting two veins only which strike from E.N.E. to W.S.W. The dip is generally S.E. 70° — 80° . The veins are mostly thin, being often less than 5 inches, but one vein is 3 feet thick and two others 1 foot. Near the outcrops, the veins are said to have been richer in quality, and were already exhausted. Ores are similar to those of the Syön-chhyön mining district. Loose portions with cavities and fissures are rich in gold content and yield 0.0029% of gold and 0.0027% of silver.

Yöng-moru (South Phyöng-an-do).—The mining district is situated about $1\frac{1}{2}$ ri W. of Chă-mo-san Mine and about 1 km. N. of Am-chök-ri station. The working was more or less actively carried on about 5 years ago. At present the mine is worked by a few miners under the management of Messrs. Okura & Co. of Japan.

In the neighbourhood of Yöng-moru, numerous veins are found on a hill composed of gneiss and granite. Four or five chief veins dip generally E. or S.E. with steep inclinations. Their thickness varies from 2 inches to a foot. Ores are the same as those of the Chă-mo-san Mine.

Tang-kokăi (Kang-uön-do).—The mine is situated on a mountain side, about 1 ri N.N.W. of Keum-syöng. It is said that the mine has been worked in ancient times. In 1897 the mine was transferred to a German, who has introduced some improvements. For 3 years, prospecting was actively carried on without much success, and in the fourth year the mine was abandoned. The rocks here are the Palæozoic quartzite, clayslate and limestone, intruded by quartz-porphyry. The strata trend N. 80° E., dipping S. 40° . As the mine has long been abandoned, the conditions of the veins are not well known. There are numerous veins which run from E. to W. They are all thin, their thickness being less than 1 foot. Ores

are quartz, carrying galena, pyrite, etc., good one yielding 0.0058% of gold and 0.0020% of silver.

Koa-moru.—The mine lies $\frac{2}{3}$ ri W. of Yöng-dök-uön, which is situated about 3 ri S.W. of Hong-chhyön. The mine was opened 20 years ago. The output at present is very limited, and only 4-8 momme of gold is said to be obtained per diem. The mining district is composed of two-mica-gneiss, striking N. 20° E. and dipping W. 50°. Among 5 principal veins, the most important one runs N. 55° W. with a dip S.W. 75° and attains a thickness of 7-8 feet, extending about 1500 feet on the strike. Ores are like those in the Chä-mo-san or Chik-san Mines.

Chyang-bat (North Kyöng-syang-do).—The mine is located on Thyön-ma-san, about 7 ri S.W. of Chhyöng-syong. The date of discovery is not recorded, but the mine was already at work 8 years ago and is now worked by 20-30 miners. The district consists of the Mesozoic clayslate and sandstone, intruded by quartz-porphyry. The dip of strata is generally E.S.E. 10°-20°. Numerous veins, composed of clay or quartz, are found in quartz-porphyry and also in the Mesozoic. They run almost parallel to one another from N. to S., dipping almost vertically. They are all thin, rarely attaining a thickness of over 5 inches.

Chyung-ni.—The mine is located on a mountain side of the north of Chyung-ni, about 4 ri S.S.E. of Eui-syöng. The mine was opened about 10 years ago, and worked since then only for 2 years. The district is composed of the Mesozoic sandstone, clayslate and schalstein, with granite and quartz-porphyry. More than a score of veins, consisting of quartz or clay, are found in the granite. They run almost parallel to one another from N. to S. Their dip is steep or vertical. The thickness is generally 2-3 inches and sometimes 1 foot.

Sai-mok.—The mine is situated on the top of a hill, about $1\frac{1}{2}$ ri S. of Chhang-chhyon, about 4 ri W. of Syong-jyu. It was opened about 3 years ago and is now worked by scores of miners. Granite-gneiss in the district has a strike N. 20° W. and is decomposed and very loose. A fissure in the gneiss which is 0.1—0.3 inches wide and runs in the same direction as the strike of gneiss, is filled up with red-brown or dark-brown, loose sandy clay, sometimes with small quartz fragments, and may be traced for 1200 feet along the strike. The loose sandy clay contains gold.

Heuk-syu.—The village of Oi-heuk-syu is situated about $2\frac{1}{2}$ ri of Ko-ryong. To the north of the village lies Nai-heuk-syu and on the opposite bank beyond the river Pöp-am. The date of discovery is not recorded but about 20 years ago the mine was reopened and at present scores of miners are at work.

Abundant quartz veins are found on the tops and flanks of the mountains near Nai-heuk-syu and Pöp-am, and they traverse sandstone and clayslate, and also the contact zone of these sedimentaries with quartz-porphyry. They run in two directions, N.—S. and N.W.—S.E. with steep or almost vertical inclinations. The veins are generally thin or of 2—5 inches in thickness, but sometimes 1—2 feet thick, some extending over 1000 meters on the strike. Ores are white, hard and compact quartz, with disseminated pyrite or carrying clay in the fissures and in both hanging and foot walls. The loose portions are generally rich in gold. The ores which is said to have been mined from a vein now drowned in water, are grey quartz, containing pyrite and yields 0.0030% of gold and 0.1040% of silver. The vein is said to be 1 foot in thickness.

Yong-dam (South Kyöng-syang-do).—The mining district is situated on the north of Yong-dam about $3\frac{1}{2}$ ri N.W. of Ma-san-pho, and embraces a mountain range of 200—300 m. in height, which

separates Chhang-uön, and Chhil-uön from Ham-an. The mine was opened a few decades ago and now scores of miners are at work. As the mine lies near Ma-san-pho it has long been known to the Japanese.

The district consists of the Mesozoic clayslate with subordinate layers of sandstone and intruded by abundant dykes and sheets of porphyry and porphyrite. The dip of the strata is generally 15° to the E. or E.S.E. Numerous quartz veins traverse clayslate and its contact zone with quartz-porphyry. They are all thin, being generally less than 5 inches but sometimes reach 1 foot in thickness and dip in general to S.W. or W.S.W. with steep inclinations or are vertical. Ores are quartz, sometimes associating calcite, clay or small fragments of mother rocks, and yield free gold often visible to the naked eye. The gold content of ores is generally 0.001%.

II. PLACER GOLD.

Placer gold occurs in two ways, viz: eluvial and fluvatile deposits. The eluvial deposit is restricted in gneiss and granite regions, the two rocks as already mentioned, sometimes containing a small quantity of fine gold and minute auriferous quartz veins. Placer gold raised from a few placer fields in Chik-san and Keum-gu mining district is of this category. The greater parts of the placer gold in Korea is raised from the fluvatile deposit.

The payable bed for placer gold lies generally 10—20 feet below the ground, but sometimes its depth diminishes to 5 or 6 feet or reaches to 60—70 feet. The gold is said to be especially rich direct on or near bed rock or extending into it in crevices and along joints to a depth, in places, of one foot. The thickness of the payable bed varies from a few inches to 3 feet. It is difficult to know the average value of the ground, but according to the inspec-

tions made by the Shibusawa and Asano Company, some ground in the Chik-san placer field has yielded $4\frac{1}{2}$ momme of placer gold and in the Syun-an placer field 6 momme per 6 square feet, in both cases the payable bed being at a depth of 20 feet and $2\frac{1}{2}$ feet in thickness.

Placer gold is found throughout the peninsula, especially in rivers and valleys in the gneiss and granite regions, and so placer fields are too numerous to mention individually. Placer gold seems to bear an intimate relation with gneiss and granite, inasmuch as the greater part of the gold is derived from the disintegration of gneiss and granite, whereby gold disseminated or scattered through the rocks or contained in veins and fissures, is concentrated *in situ* or drifted to form fluvial deposit with sand and gravel.

Placer gold was known and worked by Koreans from very remote times and it is said that the working for placer gold from 20 years ago has culminated during the first ten years. Indeed the duration of the prosperity of placer gold is rather short, and so even the actively worked field fails in few years and at last has to be abandoned. I shall here only mention the localities of the placer fields now known, but farther prospectings will probably occasion the discoveries of fields of economic importance. One of the difficulties in the way of working is to get sufficient water for washing gold; during the dry season which continues from September to March of the following year, the water required in the placer fields far exceeds the supply, especially in South Korea, and in North Korea the working is often brought to a standstill, on account of the freezing of the water.

Ham-gyöng-do.—The working for placer gold is now in a declining state, less than ten thousand miners being engaged in the industry. About 25 years ago the Yöng-heung river and its tribu-

taries were vigorously worked by many tens of thousands of miners for several years. Since the principal placer fields were worked out the laborers have decreased very much, and at present their number does not exceed 500 even in summer. The mining for about 10 ri along the Tal-ha-chhi river, a tributary of the Chyang-jin-gang; about 18 ri along the upper Peuk-tai-chhyön and also about 10 ri along the Nam-tai-chhyön, together with their tributaries, were enormous, each of these having been worked actively for placer gold by several thousands of miners, who at present are diminished to a few hundreds in number. The placer fields, extending for about 17 ri along the Chyang-jin-gang from Ko-am, about 1 ri S. of Chyang-jin, northeastwards to Kang-gu-pho, which is found on a tributary of the Chyang-jin-gang, at about 5 ri N. of Chyang-jin, were ever actively worked, but now by less than 40 miners. The placer fields which were actively worked but now abandoned, are : Chhyöng-bahoi, lying on the east of Yu-syöng ; Myöng-tai-dong, about 15 ri N. of Ham-heung and Han-tai-dong, about 1 ri N. of Työng-phyöng. The placer fields :—Sam-hak-kol, about 6 ri S.S.W. of Kyöng-uön and Na-ton of On-syöng, in its neighborhood ; the lower and upper Un-chhyong-gang ; the upper Chin-tong-gang, about 6 ri E.S.E. of Kap-san, and Yong-chi-uön and its upper course, about 8 ri S. of Wön-san ;—were more or less actively worked, more than 200 miners having been engaged in the works, but at present only 20-50 men are at work. The placer field of Chyong-san-dong between Kyöng-uön and Hoi-ryöng was opened a few years ago but is now almost wholly abandoned. The placer fields which were worked to certain extent and are at present abandoned are :—Syang-myön, along abundant tributaries in the west of Mu-san-nyöng, about 4 ri N. of Hoi-ryöng ; the lower Chyang-jin-gang at the west of Sam-syu ; Nam-työm of Chyang-jin in the upper Chyung-gang ; Keum-chhyang of Kap-san, along a tributary

of Nam-tai-chhyön ; Kon-pha, about 3 ri N. of Peuk-chhyang ; and Syong-jin-gang of Työng-phöng.

Phyöng-an-do.—Phyöng-an-do ranks first in the output of placer gold in the past as well as in the present. Since 30 years ago the workings have been greatly developed and for 20 years they had been enjoying the glory and delight of prosperity, but now are in a declining state. Syök-am-ni placer field, known as the Syun-an placer field, is now vigorously worked by about ten thousand men, the monthly yield of gold being 17,000—20,000 momme. As the good payable districts have been gradually worked out, the field is in a declining state. The placer fields scattered along Chhyöng-chhyöng-gang from its source to An-jyu and also along its tributaries, among which those in the vicinity of the villages Syöi-chuk-chyung-dong, Yong-deung and Chhyön-dong are most important, were actively worked by more than ten thousand men but have gradually declined since 1896 and at present only 200-300 men are at work. The placer fields along the Cha-syöng-gang, from its source to its mouth, and its tributaries, were worked by several thousands of miners since 1876, but from 1886 the number of workmen has been gradually decreasing, till now only about one hundred of them are occupied at this work. Tök-hyön-tong placer field, about 4 ri E.N.E. of Eui-jyu, was actively worked by several thousand men for two years since 1896, but at present only a score of them are at work. The placer fields from Peuk-chin to Sin-phung, about 2 ri N.N.W. of Yong-pyön, along Ku-ryong-gang, are now abandoned but were actively worked by more than a thousand miners about ten years ago. The placer fields which used to be worked by several hundreds of miners, and are now almost abandoned, only 10-60 being at work, are : Tai-hu-jyu, about 20 ri E. of Hu-chhyang ; the Un-syöng-gang and its tributaries between Pu-chi-ri, about 4 ri S. of

Kang-gyöi, and An-chhal-li, especially Nyö-chin-uön and its vicinity ; Syo-koan-yuk-ri, a tributary of Sam-tari-gang ; the Tai-nyöng-gang, from Tong-chhang to Hoan-eung-ni, about 4 ri S.S.W. of Thai-chhyön ; the tributary of Tai-dong-gang, taking its rise at the southeast of An-jyu ; Hoa-ryöng-ni, about 4 ri N.W. of Chä-san ; the rivulets in the environs of Ap-eun-san Mine. The placer fields which used to be worked by several hundreds of miners but are now utterly deserted, are : Tai-koan, the upper Tai-nyöng-gang, about 7 ri S. of Sak-jyu ; the Nai-ok-gang and its tributaries ; the rivulets, flowing down from the Yöm-nyöng-ni between Keui-syöng and Nam-chhang ; and the upper Tai-dong-gang and its tributaries, from Tök-chhyön to Kil-chài, about 13 ri E.N.E. of Yong-pyön. The following placer fields are less important, the first seven being at present worked by less than 50 miners and the next six being abandoned :—Pho-phöng, about 8 ri N.E. of Hu-chhyang ; Tök-chyong-ni, about $4\frac{1}{2}$ ri N.E. of Hu-chhyang ; Kil-syang-ni, on the rivulets flowing down from the mine there ; the upper course of the river flowing down to Nap-chhyöng-työng between Työng-jyu and Ka-san ; Chä-mo-san, on the rivulets flowing down from the mine there ; I-myo-ha-ri, about 1 ri N. of Kui-syöng, on the rivulet of a tributary of the Tai-dong-gang ; Syuk-chhyön and its vicinity ; Yon-tai-dong, on the lower course flowing down from the mine there ; on the river starting at the Kal-eung-nyöng, from its source to the north of Sak-jyu ; Syang-koang-dong, on the rivulet coming down from the mine there ; Syang-dan-dong, a tributary of the Sam-tari-gang, about 5 ri E. of Eui-jyu ; Syön-chhyön, on the rivers flowing down from the mine there ; and Syö-chyöi-san-tong, about 5 ri N.W. of Phyöng-yang.

Hoang-hai-do.—The placer fields are rather limited in their distribution as well as in their number, and the workmen engaged do not exceed a thousand in number even in a famous field. The

oldest field now known was opened about 30 years ago and the first ten years was the most flourishing period. The placer fields in Syang-hoa, including Nam-työm, Oi-työm and Chyung-työm, each of which is distant from Syang-hoa, about 1 ri W., 6 ri S.E., and 2 ri S.E. respectively, were worked actively 10—20 years ago, the first being worked now by about 100 men and the latter two by 10—20. The placer fields :—the neighborhood of Syu-an Mine, on the tributaries of the Tai dong-gang and Yöi-syöng-gang ; Yul-chi, about $2\frac{1}{2}$ ri N.N.E. of Chhyuk-chhyön between Chyang-yön and Hai-jyu ; the vicinity of Paik-chhyön ; and Yul-pho, about 3 ri S. of Paik-chhyön :—were more or less actively worked for some years, but at present only 10—30 men are at work. Chhyöng-sanni placer field, about 2 ri W.S.W. of Chyuk-chhyön, is less important and is at present abandend.

Kyöng-geui-do.—There is no placer field worked, except an area belonging to the Chick-san Mine. The placer fields of Ko-il-li, about $3\frac{1}{2}$ ri N.N.W. of Pho-chhyön and of Syang-phum-ni, about 5 ri N.N.E. of Yö-jyu, are less important.

Kang-uön-do.—There are 3 placer fields worked, where the workmen more than one hundred, are to be found ; that is, Tang-kokai, about 5 ri N.N.W. of Keum-syöng, on the lower course of the stream coming down from the mine there, about 300 men are at work ; Uön-thal-li, about 4 ri N.N.W. of Chhyun-chhyön, along the Nang-chhyön-gang, the miners, more than one hundred, are at work ; and Yang-dök-uön, about 3 ri S.W. of Hong-chhyön, along a tributary of the Hong-chhyön-gang. Among the following placer fields, the first ten are at present worked by 10—50 men, while the remainder are utterly deserted :—Keum-gok, about $3\frac{1}{2}$ ri W.N.W. of Hoi-yang ; Phan-keui-ri, about $4\frac{1}{2}$ ri E. of Hoi-yang ; Syöi-pho, about 4 ri N.W. of Phyöng-gang ; Ha-tai-ri, about 1 ri E. of Nang-

chhyön ; Ko-röi-ri, about 1 ri S. of Nang-chhyön ; Tök-to-uön, about $\frac{1}{2}$ ri S.W. of Chhyun-chhyön ; Koan-chhyöl-li, about 9 ri S.W. of Chhyun-chhyön ; Chyöng-san, about 8 ri S.W. of Uön-jyu ; Chhyön-pho in Chhyung-chhyöng-do, facing Chyöng-san beyond the Tai-dong-gang ; Mol-un, about 5 ri E. of Chyöng-syön ; Hoang-pho, about 2 ri S.S.W. of I-chhyön ; Ko-pan-san, about $4\frac{1}{2}$ ri W.N.W. of Yang-gu ; Kyöng-dong-ni, about $\frac{1}{2}$ ri N. of Phyöng-chhyang ; and Tyo-tun-ni, about $1\frac{1}{2}$ ri S.W. of Phyöng-chhyang.

Chhyung-chhyöng-do. During about 25 years until 5 years ago, mining in the numerous placer fields was actively carried on but at present the workmen do not exceed a hundred in all. The famous placer fields, which used to be worked by several hundreds of miners, are:—Chyok-chi-tong, about 1 ri W. of Eum-syöng ; Uön-am, about $3\frac{1}{2}$ ri S. of Po-eun ; Chyang-tai, about $2\frac{1}{2}$ ri S. of Hoang-gan ; the vicinity of Yöng-dong ; the neighborhood of Thyön-an ; Seung-thyön, between Thyön-an and Mok-chhyön f Chhyöng-yang, especially the vicinity of Yök-chhyön. They are all abandoned, except 3 placer fields, Uön-am, Thyön-an and Seung-thyön, which are still being worked. The following placer fields are less important, the first 3 being worked by less than ten men and the remainder being abandoned :—No-chhyön, about $1\frac{1}{2}$ ri S. of Hoang-gan ; Tu-man-dong, about $2\frac{1}{2}$ ri N.N.E. of Koang-jyu ; Tong-chhyön, about $1\frac{1}{2}$ ri W. of Koang-jyu ; the minor fields along the Han-gang, between To-tam, about $1\frac{1}{2}$ ri N. of Tan-yang, and Myöng-o, about 3 ri S.W. of Chhyöng-phung ; Syöl-dol, about 2 ri S. of Chhyöng-jyu ; and Syong-työng, about 1 ri N.W. of Tai-tari, between Koang-jyu and Yön-gi.

Chyöl-la-do. The placer fields of Yang-pal-li of Im-sil, about $5\frac{1}{2}$ ri S. of Chyön-jyu and of Tong-chhang, about 4 ri S. of Na-jyu, are now worked by 200—300 miners. Abandoned placer fields are

found in the following places :—Chin-san ; Chyön-do and Hu-do, along Keum-gang, about 1 ri N. of Mu-jyu ; Syöl-chhyön, about $3\frac{1}{2}$ ri E. of Mu-jyu ; Peuk-chhang, about 1 ri S. of Mu-jyu ; Sin-chhyön, about $2\frac{1}{2}$ ri S. of Mu-jyu ; Mul-gul-li, a tributary of the Keum-gang between Yong-dam and Chin-an ; Pai-kok and Tal-gil-li, about 5 ri W. of Chin-an ; Kal-dam, about 4 ri S.W. of Im-sil ; Kyo-ryong, $2\frac{1}{2}$ ri N. of Nam-uön ; Yön-pha-työng between Nam-uön and Ku-ryöi ; Chhyo-gyöi of Nam-uön, about $2\frac{1}{2}$ ri E. of Syun-chhyang ; Syöi-gol, about $\frac{1}{2}$ ri S.E. of Sya-chhang at about 4 ri N. of Po-syöng ; and No-dong, about 2 ri N. of Po-syöng.

Kyöng-syang-do. The placer fields in Ma-jyang-ni and Sal-phyo-djyöng, which are near the famous temple of Hai-in-sa, about 11 ri N. of Hyöp-chhyön, were opened in 1904 and about 200 men are now at work there. They are now the most flourishing in Kyöng-syang-do but the area is quite limited and will be soon worked out. The placer fields :—Päik-chhyön-tari between Ko-ryöng and Syöng-jyu ; Chhang-bat and Pi-gok of Chhyöng-syang, in the valleys around the mine there ; Heuk-syu, in the valleys coming down from the mine there ; and Yong-dam of Chhyang-uön and its neighboring district belonging to Chhil-uön and Ham-an, in the valleys around the mine there ;—were ever worked with much activity, but now only 20—50 men are employed. The following abandoned placer fields will here be mentioned :—To-chhyön, about 2 ri E.S.E. of Pong-hoa ; Keum-tang, about 2 ri W.N.W. of Yöi-chhyön ; Chhung-ni, in the valleys near the mine there ; Hong-kok, about 1 ri S.W. of Yöng-chhyön ; Chhyöng-kyöng and Syang-gyöi, about 4 ri E. of Yöng-chhyön ; Uön-to-kol (Syu-syöng), about 1 ri N. of Syang-gyöi ; Kam-sil, about $9\frac{1}{2}$ ri N. of Kyöng-jyu ; Syök-chyang-ni, about 1 ri N.W. of Kyöng-jyu ; Yang-mok of In-dong, near the station of Yang-mok ; Kak-san, about $1\frac{1}{2}$ ri S.S.W. of the

same station ; U-kok, about 2 ri S.E. of Hai-in-sa ; Uöl-koang-ni, about $\frac{1}{2}$ ri S.E. of U-kok ; Ku-pok, about 2 ri S. of Mil-yang ; Oa-ji, about 1 ri W.N.W. of Ku-pok ; and Paik-sa, about $2\frac{1}{2}$ ri N.W. of Ham-an.

III. SILVER AND LEAD MINES.

There are several deposits of silver and lead ores, but as none are worked at present their mode of occurrence is not clearly understood. The deposits are all of quartz veins with galena, containing silver and gold.

O-man-tong (South Ham-gyöng-do).—The mine is situated on a mountain flank, about 3 ri N.W. of Chyang-jin. It was opened some hundred years ago and reopened about 30 years back, the working being continued until 1902 and yielding daily several hundreds kin of lead and some silver, when it was actively worked. It is said that the vein consists of quartz gangue with numerous ore-strings which are 0.1—1.0 foot wide, and the thickness of it varies in a wide range from 1 foot to over 10 feet. The ore-string is composed of argentiferous galena, zinc-blende, pyrite, etc.

Chhang-phyöng (North Phyöng-an-do).—The mine is situated in the village of Chhang-phyöng, about 5 ri S.S.E. of Ui-uön. It was opened about 30 years ago and worked since then for 5 years. Two quartz veins 5 inches thick, with argentiferous galena, occur in garnet-bearing granite-gneiss and dip E.S.E. steeply.

So-min-dong.—The mine is situated on a mountain flank at about 1 ri S. of the village of So-min-dong, about 9 ri E. of Yong-pyön. It was worked at times since several hundred years ago but about ten years back it was utterly abandoned. Numerous minor veins of a thickness less than 1 inch or sometimes 1 foot, traverse the Palæozoic limestone. They intersect one another in networks, forming an irregular mass, and sometimes attaining a thickness of 30—40 ft

It is extended for about 1800 feet in length along the strike of limestone, that is, N. 35° W. Ores are quartz with argentiferous galena.

Ta-tök-ri (North Kyöng-syang-do).—The mine is situated about 1 ri N.E. of Pong-hoa. It was opened about 15 years ago and worked for 3 or 4 years. It was reopened about 8 years ago and abandoned again after being worked for 1 or 2 years. One vein 3 feet thick, is found in quartz-porphyry. It runs from N. to S. Ores are quartz, containing argentiferous galena, chalcopryrite, pyrite, etc.

Päik-uöl-san (South Kyöng-syang-do).—Päik-uöl-san stands at a distance of about 2 ri N. of Chhyang-uön. At the north of the mountain lies a village, Peuk-kyöi, and at the south, Pan-ya-dong. The district is composed of green porphyrite. On the mountain flank of the north of Pan-ya-dong, abundant small ditches or basin where the ores were mined in former times, are arranged in a N.—S. direction. The abandoned ores generally contain 0.0010 % os silver. In the valley of Peuk-kyöi we see a quartz vein of 0.2—1.0 foot thick, extending over one thousand feet on the strike, which is N.—S. or N. 20° W. Numerous abandoned mines are seen along the vein.

IV. COPPER MINE.

Except the Kap-san Mine there is none worked for copper. The mode of occurrence of the copper deposits is not well known but we may roughly divide them into three classes:—1, metalliferous veins, as in the Chhyang-uön Mine; 2, contact deposits, as in the Tong-työm and Sin-työm Mines; and 3, metasomatic deposits, as in the Kap-san Mine.

KAP-SAN MINE.

This mine is situated in the village of Ko-chin-dong, about 7 ri

E. of Kap-san. Communication and transportation depend upon the road running from the mine to Peuk-chhyang through Kap-san, the distance being about 35 ri, and Sin-chhyang, the harbour, may be reached within 4 ri of Peuk-chhyang. The mine was discovered and worked more than a thousand years ago by a Chinese. Since it was known by Koreans as a profitable investment, the Korean government transferred the mine to the management of Koreans. About 24 years ago it was worked under the direct control of the Imperial House of Korea and for two years the most prosperous period in the history of the mine set in, about 20,000 miners earning their living by the mine. At present there are 40 miners employed in the mine and the total population of the village is about 2000. The production of copper is not exactly known but is estimated to be 40,000 kin from 240,000—360,000 kin of ore monthly.

The mining district consists of the alternation of limestone and marl, with interbedded clayslate and sandstone. These rocks are often metamorphosed by the contact of granite and overlaid by basalt-flow or intruded by basalt-dykes. The strike of the strata is N.—S. or N.N.E.—S.S.W. and the dip is E. or W., forming folded strata. The deposits occur in limestone, and form large irregular masses of sulphides replacing limestone along its stratification. They are found to extend from N. to S. and to dip E. 50° — 60° . The deposit now worked is the third one ever found, its perceptible extension being 70—80 feet and the thickness being over 20 feet in the most favorable case. Generally the boundary of the deposit with the country rocks is rather sharply defined. Ores are chalcopyrite with some admixtures of arsenopyrite and pyrrhotite, but without any gangue or contact minerals. The percentage of copper in the ores is generally high, and it is 20 % in the rich ore and 5—6 % in the poor one,

with an average of over 10 %. The following is the result of the chemical analysis of an average ore :—

Cu.	Fe.	S.	SiO ₂ .
12.07 %	45.44 %	37.40 %	0.66

THE MINOR COPPER DEPOSITS OR MINES.

Tong-työm and Sin-työm (South Ph्यों-an-do).—Tong-työm is situated about 7 ri S.W. of Hu-chhyang and Sin-työm about 2½ ri S. of Tong-työm. The mines in the two places were opened about 60—70 years ago and worked until the year 1904, though twice or thrice they encountered the misfortune of having been abandoned. About 300 men had been engaging at times in the mining until the year 1874, thence the number of miners decreased gradually. The copper deposits occur in the contact zone of the Palæozoic limestone with interbedded clayslate, with granite. The two copper deposits in Tong-työm run almost parallel each other from N.N.E. to S.S.W. The deposit in the west is 5 feet thick and dips W.N.W. 70°, and that in the east is 1½ feet thick, dipping E.S.E. 70°. In Sin-työm, chalcopyrite, associated with quartz, pyrrhotite and galena, forms several minor bands running parallel to one another along the contact zone.

Chhyang-uön (South Kyöng-syang-do).—The mine is situated about 1 ri N. of Chhyang-uön. It was opened about 20 years ago and worked under the control of the Imperial House of Korea. In 1893 it was transferred to the management of a Japanese. The mine yielded about 20,000 kin of ore monthly in 1904, but in 1905 the rich ores were worked out and the mine was abandoned in the same year. One vein is here found in green porphyrite and runs N. 10° E., dipping W. 60°—70°. The thickness of the vein is 1—2½ feet. It extends 50—60 feet on the

strike, and gradually thins away at both extremities. Ores are chalcopyrite with admixtures of pyrite and mother rocks, yielding in general about 20 % of copper.

V. IRON MINES.

Iron ores are of three kinds : hematite, magnetite and limonite. Their mode of occurrence may be divided into three classes : 1, beds, as in Kai-chhyön ; 2, veins, as in Sin-chhyön ; and 3, contact deposits, as in Maik-mil-dong and Ma-san-pho. A few deposits in Phyöng-an-do and Hoang-hai-do are now worked, the ores being reduced for the manufactures of farming tools, etc., for local use.

Mi-chhyön (South Phyöng-an-do).—The mine is situated at the east of the village Mi-chhyön, about $1\frac{1}{2}$ ri W. of Kai-chhyön. It was opened about 10 years ago and at present 40—50 miners are at work. The output is about 15 kwamme¹ of ore a miner per diem. One limonite bed is inserted in marl and dips N.W.60°. It has a thickness, varying from 4 to 12 feet and may be traced for 600 feet along the outcrop. Ores contain 62.25 % of iron.

Sin-kokäi—The mine is situated on the mountain flank at the southeast of the village Sin-kokäi, about $2\frac{1}{2}$ ri S.W. of Kai-chhyön. At present 15 miners are at work, yielding 4200—5000 kwamme of ore a month. The country rock is marl with interbedded clayslate. One limonite bed, 6—12 feet thick, is found in clayslate and dips N.W.20°. The ores contain 65.4 % of iron.

Chyön-bahoi—The mine is situated on the mountain side of the village Chyön-bahoi, about 2 ri S.S.W. of Sin-kokai. It was earliest known by miners among the iron deposits of Kai-chhyön but now only 4 or 5 miners are employed. Here clayslate alternates with marl and quartzite. Four limonite beds of 4—5 feet

1. Measure of weight 1. Kwamme = 3.75 kilogr.

thick are inserted in clayslate, run S.20° E., and dip E.15°. Ores contain 64.32 % of iron.

Kulmoi-san of Sin-chhyön (Hoang-hai-do).—Kul-moi-san is an isolated hill, 24 m. in high, having a base 600 m long in circumference. It is conveniently situated on the bank of a tributary of the Chäi-ryöng-gang and about 3 ri E.S.E. of An-ak. The hill consists of grey or black clayslate. A vein is found in the western part of the hill and runs from N.W. to S.E. It is wedge-shaped and thickest in the north, being 28 m. thick and becomes gradually thin toward the S.E. Its extension is only 45 m. The vein was worked in 1904 and 800—900 kwamme of ores were then transported to Ché-mul-pho. Ores are hematite, rarely accompanying limonite. The following is the result of the chemical analysis :

Fe.	SiO.	S.	P.	Sp. gr.
62.70%	0.93%	0.01%	0.061%	3653

Keum-san-pho.—The iron deposits crop out on the hill at the east of the village Keum-san-pho, about 3 ri N. of Eul-lyal and also on the hill of Ha-phyöng-chhon of Chyang-nyön, the opposite bank of Keum-san-pho. The country rocks are highly decomposed and seem to consist of the alternation of the Palæozoic limestone and clayslate, running N.40°—60°W. and dipping S.W. 40°. The mode of the occurrence of the iron deposits is not yet ascertained. Blocks of limonite and hematite of a size, varying from a pea to a human head, together with clayslate and quartz, are found abundantly scattered in a brown clay on the hills, especially near the surface. They are collected and sold as materials for iron works. On the east of Keum-san-pho, one deposit is interbedded in limestone. The deposit now worked, forms a lenticular mass, 6 feet thick, 20 feet long and 20 feet wide. Besides these, small hematite veins occur in clayslate. The ores on the hill were probably derived from these

deposits by disintegration. The ores were first mined in 1899 and at present a few of the deposits are worked in places. The following is the result of chemical analysis of the ores

		Fe.	Mn.	SiO ₂	S.	P.	Sp. gr.
Keum-san pho.	Limonite	51.91	0.86	6.81	Trace	0.067	3.818
Ha-phyöng-chhon.	„	55.15	1.56	6.46	„	0.126	3.782
Boundary district.	Hematite	60.24	0.48	7.00	„	0.040	4.770

Ku-ri-pang.—The hill of Ku-ri-pang, about 1 ri E. of Chai-ryöng, consists of clayslate, sandstone and conglomerate, running N.60°—75° E. and dipping W.N.W. 20°—30°. The rocks are highly decomposed and form a thick clayey deposit on the surface. Blocks of hematite and limonite of several sizes of from a pea to a human head, are found scattered on the hill or sometimes intermixed in clay to a depth of 1—3 feet, and up to 10 feet in shallow valleys. Sometimes they are concentrated in the form of the bed. They are now mined by Koreans. The following is the result of the chemical analysis of the ores :

	Fe.	Mn.	SiO ₂	S.	P.	Sp. gr.
Rich ore.	53.61	0.23	8.85	0.08	0.038	3.565
Poor ore.	50.99	0.82	12.49	Trace	0.070	4.836

Maik-mil-dong (Kang-uön-do).—The magnetite deposit occurs in the contact zone of hornblende-schist with syenite-granite on the mountain flank, about 4 ri S. of Thyöl-uön. Its thickness reaches 30 feet when swollen. Ores are black and hard titaniferous magnetite, yielding 49.56 % of iron and 1.52 % of titanium.

Ma-san-pho (South Kyöng-syang-do)—An iron deposit is found near a pass, about 1 ri E. of Ma-san-pho. It occurs in the contact zone of the Mesozoic clayslate with granite and extends from N.N.W. to S.S.E. Ores are magnetite and limonite.

VI. GRAPHITE.

Numerous graphite beds are interbedded in gneiss and crop out in the neighborhood of Yang-bang about $1\frac{1}{2}$ ri W.N.W. of Ham-chhyang in North Kyōng-syang-do. They are 1—4 feet thick when swollen but are soon separated into thin bands. Two years ago about 32,000 kwanme of graphite was mined and transported to Tōkyō.

In the Palæozoic region, about 3—4 ri N. of Eun-san in Sonth Pyōng-an-do, graphite was worked by the British Coöperation Company.

VII. COAL.

Coal occurs both in the Mesozoic as well as in the Tertiary. The Mesozoic coal except that in Sa-ri-uōn belongs to anthracite and the Tertiary coal to the lignite of inferior quality, both being non-caking.

1. *Mesozoic Coal.*

The coal field in the environs of Phyōng-yang (Sonth Phyōng-an-do)—The coal field is a low and hilly tract of 10—150 meters high and is conveniently situated, near the Tai-dong-gang, by which transportation is easily effected.

The strata there are the alternation of sandstone and shale, and run N. 80° E., dipping N. or S. Foldings and faults are very frequent and make the mining difficult. Coal belongs to anthracite. It is very brittle and crumbles very readily. The following is the result of the chemical analysis of these coals :

	H ₂ O.	Volatile matter.	Coke.	Ash.	S.	Sp. gr.
Chyung-san dong.	—	16.10	73.60	6.30	0.57	—
Mun-syu-pong.	2.88	11.29	81.04	4.79	0.64	—
	6.45	15.03	74.77	3.70	0.37	1.472
	1.75	4.15	85.97	8.10	0.45	—

	H ₂ O	Volatile matter.	Coke.	Ash.	S.	Sp. gr.
Paik-yang-san.	1.83	10.05	83.77	4.35	0.56	1.402
	—	10.00	86.20	3.80	0.77	—
Yong-tang.	3.25	5.51	62.66	28.58	0.32	1.976
	3.70	8.10	75.50	11.60	0.70	—
	—	5.70	79.20	15.30	0.46	—
Ro-pang-san.	3.35	6.79	84.22	5.64	0.90	—
	1.60	10.59	78.00	8.20	0.85	—
	—	11.80	84.30	3.90	0.18	—
Sin-jyang-dong.	14.45	24.70	53.46	7.39	—	1.505

Mun-syu-pong District.—The district embraces the hilly tract to the west of Phyöng-yang, just opposite the town beyond the Tai-dong-gang. Coal seams which crop out in a zone, extending over 2 km. from Päik-yang-san, west of Phyöng-yang, south-westwards to Pam-namu-dong through Mun-syu-pong, were more or less actively worked in places about 13 years ago, and in 1904 it was mined under the management of a Frenchman, but in the next year it was again transferred to the control of the Imperial House of Korea. The coal seams are three in number, being 4—8 feet thick. Their strikes are E.—W. or N. 70° E., dipping S. 25°—40°. At Pam-namu-dong they have been dislocated by a fault and extend from the south of Chyung-san-dong to Syö-pho. Their strike is E.—W. in the east but gradually turns northward until it changes N.—S. in the west, bending like a bow. The dip is S. 40° in the east but changes eastward and at Syö-pho it is E. 45°. One important coal seam here has a thickness of 4 feet. In the western flank of Mu-ro-san one coal seam 3 feet thick, runs N. 60° E., and dips S.S.E. 20°.

Ko-pang-san District.—In the southwest of Yong-tang, about 2 ri E. of Phyöng-yang, on the west bank of the Tai-dong-gang, there is one workable coal seam, forming a syncline. The geological structure is much complicated but the strike of the strata is

in general W.N.W.—E.S.E., and the dip is N.N. E. 30° . A workable seam is said to be of 10—30 feet thick and was worked for a year, a few years ago. A coal seam of 1—6 feet thick, dipping N. 40° — 50° , is found at the east of the village and was worked a few years ago.

A coal seam on the hill side of Ko-phang-san, about 1 km. N.E. of Yong-tang, was more or less actively worked for 2 years since 1894. It is 10—20 feet thick and may be traced for about 330 m. along the outcrop. Its strike is E.—W. and the dip is N. 30° .

There rises Tai-syöng-san at the north of Yong-tang, on the foot of which a coal seam about 12 feet thick was worked about 8 years ago. To the north of the mountain we see another coal seam 5 feet thick.

Besides the coal seams mentioned above, we may find, in the village of Kam-peuk-uön, about 1 ri N. of Phyöng-yang, a coal seam of 3 feet thickness, which holds the strike N. 70° E. and the dip N.N.W. 20° . At Heung-pu-ri, about 1 ri N.E. of Phyöng-yang, and also at Chhil-syöng-mun of Phyöng-yang, thin coal seams are found.

In a hill to the northwest of Sin-jyang-dong, about 4 ri E. of Phyöng-yang, there are a few coal seams, one of which has a thickness of 2—3 feet and was once worked. The strata are severely disturbed but in general they strike N. 50° — 80° W., and dip S.W. 60° .

A coal seam which extends from Ma-syang-dong, about 6 ri E. of Phyöng-yang, to Sin-sa-dong, is 5—10 feet thick and dips S.S.E. 30° .

The coal field in Sam-deung.—The village of Tho-tari is situated along the road between Phyöng-yang and Sam-deung, about 8 ri E. of Phyöng-yang, and is 2 km. distant from the Tai-dong-gang. Coal seams crop out here and there in the district about $\frac{1}{2}$ ri

westwards from Sut-kokäi, about $\frac{1}{2}$ km. E.N.E. of Tho-tari. They are interbedded in shale and sandstone, dipping N.N.E. 50° . One important seam is 3—6 feet thick and was worked 10 years ago. Coal belongs to anthracite. It is very brittle, and yields few lumps. The following is the result of the chemical analysis :

H ₂ O.	Volatile matter.	Coke.	Ash.	S.	Sp. gr.
5.65	8.82	77.46	8.07	0.27	1.568
4.98	7.55	78.10	9.37	0.31	1.593
3.57	5.80	69.20	21.43	0.28	—
—	16.90	81.30	1.80	0.55	—

The coal field in Sa-ri-uön (Hoang-hai-do).—Coal seams were discovered through railway cuttings in the village Sin-säi-chhon, about 2 ri E. of Sa-ri-uön, which lies about $3\frac{1}{2}$ km. of Pong-san. The strata are the alternation of shale and sandstone, running N. 20° W. and dipping E.N.E. 25° . Several coal seams are interbedded in shale. One important seam is 3 feet thick and may be workable. Coal is black and hard, and belongs to the brown coal. The following is the result of the chemical analysis of the coal :

H ₂ O.	Volatile matter.	Coke.	Ash.	S.
7.80	44.80	37.20	9.50	1.50
18.86	34.75	37.35	9.04	1.65

The coal field in Thong-sin.—The coal field is situated about $1\frac{1}{2}$ ri S. E. of Thong-sin. The rocks are shale and sandstone, accompanied by the eruption of granite, and dip S.W. 30° . One coal seam 0.4—1.5 feet thick crops out on a hill side and may be traced for over 180 feet on the strike. Coal belongs to anthracite and is very brittle. Another coal seam in the south of the town was worked a few years ago.

The coal-bearing strata of Tol-moc (North chhyung-chhyöng-do).—An isolated hill which stands on the northern bank of the

Keum-gang, opposite Syö-pho, about 3 ri E.N.E. of Kun-san, consists of clayslate with thin sandstone, dipping N.W. or N.N.W. 60°—70°. A coal seam in the clayslate is 0.8—1.2 feet thick but is likely to thin out. Coal belongs to anthracite. It is very brittle, and gives a few lumps. The following is the analysis of it :

H ₂ O.	Volatile matter.	Coke.	Ash.	S.	sp.gr.
7.13	7.82	69.09	15.96	0.33	1.954

The coal-bearing strata in Hoa-syun (South Chyöl-la-do).—In a small valley between Hoa-syun and Tong-pok, about 3 ri from Hoa-syun, a coal seam is interbedded in clayslate and sandstone, running N. 70° W., and dipping N.N.E. 45°. The thickness of it is 30 feet with 2 or 3 partings but it is liable to thin out. Coal belongs to anthracite and is very brittle. The following is the analysis of it :

H ₂ O.	Volatile matter.	Coke.	Ash.	S.	sp.gr.
9.78	8.29	58.02	24.91	0.38	1.95

2. Tertiary Coal.

Some of the coal seams in the Tertiary strata have a thickness of over 5 feet, offering a quantity sufficient for working. However they are of very inferior quality and are not adapted for first-class fuel. A small quantity is at present mined in Ham-gyöng-do for domestic use and as fuel for the evaporation of salt water. Coal belongs to inferior brown coal. It is dark brown in color, and when exposed to air it easily breaks and splits up. The composition of coal in Ul-san is shown as follows :

H ₂ O.	Volatile matter.	Coke.	Ash.	S.
20.12	40.21	32.16	7.51	5.40

The coal fields in Ham-gyöng-do.—Coal seams 3—6 feet thick are found in three places in the vicinity of Chyu-uön and Oa-tong,

about 1 ri S. of On-syöng. In Na-nam, about $1\frac{1}{2}$ ri N. of Kyöng-syöng; in Saing-keui-ryöng, about $\frac{1}{2}$ ri S.S.E. of the same town and in To-chyang-tong, the southern side of Saing-keui-ryöng, coal seams 4—5 feet thick are intercalated in the layers of clay, sand and pebble, and are worked by the farmers there. Some coal seams are found in the following localities: Uön-Syu-tai, about 1 ri E. of Kyöng-syöng; the neighborhood of Hoi-ryöng; eastern flank of Pong-hoa-chhi, N. of Myöng-chhyön; Tök-yuk-ri of Kil-jyu; Phung-nam-ni of Ham-heung; and the coast of Yöng-heung.

The coal fields in Kyöng-syang-do.—Along a small pass, $\frac{1}{2}$ ri S of Yöng-hai, two coal seams are interbedded in gently undulating shale. The upper coal seam is 1 foot thick with a parting 2—5 inches thick and the lower is 2—3 feet thick, the two seams being separated by shale 3 feet thick. At Myöng-chhyön, about $\frac{2}{3}$ km. N. of Chyang-gi, 4 coal seams of over 1 foot thick are interbedded in shale and sandstone, the total thickness being about 30 feet, and dip. N. 20° .

In Yong-dyjön, about 1 km. S. of Chyang-gi, numerous coal seams are found in the alternation of shale and sandstone. They run N. 70° E., and dip. N.N.W. 15° — 17° . An important seam is $2\frac{1}{2}$ —3 feet in thickness. A coal seam 6—8 feet thick crops out on the hills in Syang-syö-dong of Kyöng-jyu, about $3\frac{1}{2}$ ri N.N.E. of Ul-san and is interbedded in a grey shale, overlaid by grey-white tuff. The Tertiary strata of Pam-dong, about $1\frac{1}{2}$ ri E.N.E. of Ul-san overlay the Mesozoic unconformably and consist of a gently undulating shale, overlaid by a thick bed of grey-white tuff. Many coal seams are interbedded in shale and tuff, among which two are more important, the upper being 6—8 feet in thickness and the lower 3 feet thick.

VIII. Peat.

Peat occurs in alluvium at a depth varying from 5 inches to 5 feet and is 0.5—4.0 feet in thickness. The localities now known are: Păik-chhyön-pho about 4 ri of Yong-chhyön; Syang-dan, Ha-dan and Syö-syong-ni of Eui-syöng, on the north directly from Păik-chhyön-pho; No-syang-ni and Syang-dan, about 1 ri S. of Kak-san, and O-san-i-ri, about 4 ri S.E. of Työng-jyu (all in Nonth Phyöng-an-do). Peat in Yong-chhyön and Eui-jyu is 2—4 feet thick and is worked by Chinese since 10 years ago. Peat in Kak-san is 8 inches thick and was once worked by Chinese, while that of Työng-jyu is 2½ feet in thickness and was discovered in 1905. The following is the result of the chemical analysis of peat in Työng-jyu.

H ₂ O.	Volatile matter.	Coke.	Ash.	S.
13.87	49.68	23.11	13.34	0.37

INDEX

OF

GEOGRAPHICAL NAMES IN THE TEXT

Transliterated after Prof. B. Kotô and S. Kanazawa's System.

A.

A-deung-nyöng

Am-chök-ri

Am-nok-gang

An-ak

An-chhal-li

An-hyöp

An-jyu

An-myön do

Ap-eun-san Mine

牙得嶺

岩積里

鴨綠江

安岳

安贊里

安峽

安州

安眠島

殷山鑛山

C.

Chă-mo-san

Chă-san

Chă-syöng

Chai-ryöng

Chang-phyöng

Che-mul-pho

Cheung-yak

Chhai-ryöng

Chhang-chhyöng

Chhil-syöng-mun

Chhil-uön

Chho-cum-nyöng

Chho gyöi

Chho-gyöi-san

Chho-san

Chhung-yang

慈母山

慈山

慈城

載寧

倉坪

濟物浦

增若

柴嶺

倉泉

七星門

漆原

初音嶺

草溪

草溪山

楚山

春陽

Chhya-ryöng

Chhya-un-nyöng

Chhyang-nyöng

Chhyang-syöng

Chhyang-uön

Chhyön-dong

Chhyön-syöng-san

Chhyöng-bahoi

Chhyöng-chhyön-gang

Chhyöng-ha

Chhyöng-kyöng

Chhyöng-phung

Chhyöng-san

Chhyöng-san-ni

Chhyöng-syong

Chhyöng-syöng

Chhyöng-yang

Chhyu-uöl-san

Chhyun-chhyön

Chhyung-chhyöng-do

Chhyung-hoa

Chhyung-jyu

Chi-ri-san

Chi-ryöi

Chik-san

Chin-an

Chin-balbi

Chin-do

Chin-hai

車嶺

車雲嶺

昌寧城

昌城

昌原

泉洞

千聖山

青岩

清川江

清河

清京

清風

清山

青山里

青松

清城

青陽

秋月山

春川

忠清道

中和

忠州

知異山

知禮

稷山

鎮安

泥踏里

珍島

鎮海

Chin-jyu	晉 州	Chyōng-syōn	旌 善
Chin-nam-pho	鎮 南 浦	Chyong-syōng	鍾 城
Chin-po	眞 寶	Chyōn-jyu	全 州
Chin-san	珍 山	Chyu-chyōn	酒 泉
Chin-tong-gang	鎮 東 江	Chyu-uōn	周 原
Chuk-ka-ryōng	竹 駕 嶺	Chyung-gang	仲 江
Chyak-ryōng	鵲 嶺	Chyung-ni	中 里
Chyang-bat	長 田	Chyung-san-dong	中 山 洞
Chyang-gi	長 驛	Chyung-tyōm	中 店
Chyang-gyōi-jyang	長 溪 場		
Chyang-heung	長 興		
Chyang-jin	長 津		
Chyang-jin-gang	長 津 江	Eui-heung	義 興
Chyang-nyōn	長 連	Eui-jyu (Wi-jyu)	義 州
Chyang-pūk-san	長 白 山	Eui-syōng	義 城
Chyang-san-kot	長 山 串	Eul-lyal	殷 栗
Chyang-syōng	長 城	Eum-syōng	陰 城
Chyang-tai	場 岱	Eun-san	殷 山
Chyang-yōn	長 淵	Eung-pong	鷹 峰
Chyo-il-lyōng	朝 日 嶺		
Chyo-pho	助 浦		
Chyōi-jyu-dō	濟 州 島	Ha-dan	下 端
Chyōi-ryōng-san	祭 靈 山	Ha-phyōng-chhon	下 坪 村
Chyok-chi-tong	足 芝 洞	Ha-ram-san	霞 嵐 山
Chyōl-la-dō	全 羅 道	Ha-syō	下 西
Chyōn-bahoi	傳 岩	Ha-tai-ri	下 大 里
Chyōn-dō	前 島	Ha-tong	河 東
Chyōng-eup	井 邑	Hai-jyu	海 州
Chyōng-san	鼎 山	Hai-nan	海 南
Chyong-san-dong	鐘 山 洞	Haing-chhi	大 峙

E.

H.

Ham-chhyang	咸昌	Hong-chhyön	洪川
Ham-gyöng-do	咸鏡道	Hong-kok	紅谷
Ham-heung	咸興	Hong-uön	洪原
Ham-phyöng	咸平	Hu-chhyang	厚昌
Ham-yöl	咸悅	Hu-chi-dong	厚地洞
Han-gang	漢江	Hu-do	後島
Han-tai-dong	寒大洞	Hyön-näi	縣內
Heui-chhyön	漚川	Hyön-phung	玄風
Heuk-syu	黑水	Hyöp-chhyön	陝川
Heung-hai	興海		
Heung-pu-ri	興浮里	I.	
Heung-yang	興陽	I-chhyön	伊川
Ho-am	虎岩	I-hoa-ryöng	梨花嶺
Hö-chhyön-gang	虛川江	I-myo-ha-ri	梨卯下里
Hoa-dong	化洞	Ib-syök-chham	立石站
Hoa-kai-san	華蓋山	Im-jin-gang	臨津江
Hoa-ryong-ni	黃龍里	Im-sil	任實
Hoa-syun	和順		
Hoan-eung-ni	還興里	K.	
Hoang-chhi	黃峙		
Hoang-chhi-ryöng	黃峙嶺	Ka-chhi	加峙
Hoang-chho-ryöng	黃草嶺	Ka-phyöng	加平
Hoang-gan	黃澗	Ka-san	嘉山
Hoang-hai-do	黃海道	Kai-chhyön	价川
Hoang-jyu	黃州	Kai-ka-dong	開花洞
Hoang-pho	黃浦	Kai syöng	開城
Hei-ryöng	會寧	Kak-san	角山
Hoi-yang	淮陽	Kak-san	郭山
Hol-kol	忽洞	Kal-dan	葛潭
Ho-mi-ryöng	好美嶺	Kal eung-nyöng	鰲嶺

Kal-gol-lyöng	把撥嶺	Ko-chin-dong	古振洞
Kam-peuk-uön	坎北院	Ko-dong	庫洞
Kam-sil	甘谷	Ko-il-li	古日里
Kang-gu-pho	江口浦	Kö-jyöi	巨濟
Kang-gyöi	江界	Ko-kon-uön	古乾原
Kang-gyöng	江景	Kö-mun-san	巨門山
Kang-hoa	江華	Ko-pan-san	古坊山
Kang-jin	康津	Ko-röi-ri	古禮里
Kang-neung	江陵	Ko-ryöng	高靈
Kang-uön-do	江原道	Ko-san	高山
Kap-san	甲山	Ko-syöng	高固城
Keuk-syöng-dong	極城洞	Ko-syöng-nyöng	高城嶺
Keum-chhyang	金昌	Ko-ya	巨野
Keum-chhyön	金川	Koa-moru	果隅
Keum-gang	錦江	Koan-chhyöl-li	冠川里
Keum-gang-san	金剛山	Koang-chhyön-ni	光川里
Keum-gok	金谷	Koang-jyu	廣州
Keum-gu	金溝	Koang-syöng	光城
Keum-san	錦山	Koang-syöng-kokai	廣城峴
Keum-san-dong	金山洞	Koang-yang	光陽
Keum-san-pho	金山浦	Kok-san	谷山
Keum-syöng	金城	Kok-syöng	谷城
Keum-tang	金塘	Köm-san-nyöng	劍山嶺
Kil-chäi	吉在	Kon-pha	坤坡
Kil-jyu	吉州	Kon-yang	昆陽
Kil-syang-ni	吉祥里	Kong-jyu	公州
Kim-hai	金海	Ku-il-san	九日山
Kim-hoa	金化	Ku-kokai	狗峴
Ko-am	高岩	Ku-ong-bong	九王峰
Kö-chhyang	居昌	Ku-pok	九朴

Ku-ri-pang	九里坊	Mi-chhyon	美泉
Ku-ryöi	求禮	Mi-ryöng	彌嶺
Ku-ryong-gang	九龍江	Mil-yang	密陽
Ku-ryong-san	九龍山	Mo-ak-san	母岳山
Kui-syöng	龜城	Mok-chhyön	木川
Kuk-mang-san	國望山	Mok-pho	木浦
Kulmoi-san	屈山	Mol-un	沒雲
Kum-peuk	軍北	Mol-un-chhi	沒雲峙
Kun-san	群山	Mon-syu-pong	紋水峰
Kyo-ryong	蛟龍	Mon-tong-ni	夢東里
Kyöm-i-pho	兼二浦	Mu-an	務安
Kyöng-geui-do	京畿道	Mu-juu	茂朱
Kyöng-juu	慶州	Mu-ro-san	霧露山
Kyöng-syang-do	慶尙道	Mu-san	茂山
Kyöng-syöng	鏡城	Mu-san-ryöng	茂山嶺
Kyöng-uön	慶源	Mul-gul-li	勿屈里
		Mun-chhi-san	門峙山
		Mun-gyöng	聞慶
		Mun-syöng-jiang	文城場
Ma-jiang-ni	馬場里	Myo-hyang-san	妙香山
Ma-tal-san	馬達山	Myöng-chhyön	明川
Ma-thyöl-lyöng	摩天嶺	Myöng-o	鳴梧
Maikmil-dong	麥洞	Myöng-tai-dong	明太洞
Maing-san	孟山	Myör-ak-san	滅惡山
Mal-chhi	馬峙		
Man-dök-san	萬德山		
Man-ma-koan	萬馬關		
Man-pho-chin	滿浦鎮	Na-juu	羅州
Ma-san	馬山	Na-nam	羅南
Ma-sing-nyöng	馬息嶺	Na-tan	羅丹
Ma-syang-dong	馬上洞	Naing-syu-työm	冷水店

M.

N.

Nai-ok-gang	內 玉 江	Oi-peuk-syu	外 黑 水
Nak-tong-gang	洛 東 江	Oi-työm	外 店
Nam-chhyön-työm	南 川 店	Ok-chhyön	沃 川
Nam-djyön	藍 田	Ok-koa	玉 果
Nam-hai-do	南 海 島	On-jin-san	彥 眞 山
Nam-pho	藍 浦	On-syöng	穩 城
Nam-phyöng	南 平	On-yang	彥 陽
Nam-tai-chhyön	南 太 川		
Nam-työm	南 店		
Nam-uön	南 原	Päi-kok	梨 谷
Nam-yang	南 陽	Päik-chhyön	白 川
Nang-chhyön	狼 川	Päik-chhyön-pho	白 川 浦
Nang-chhyön-gang	狼 川 江	Päik-chhyön-tari	白 川 橋
Nang-nim-san	狼 林 山	Päik-hyön-ni	白 峴 里
Nap-chhyöng-djyöng	納 清 亭	Päik-pong-nyöng	白 福 嶺
Neung-dong	菱 洞	Päik-sa	白 沙
No-chhyön	老 川	Päik-tu-san	白 頭 山
No-dong	蘆 洞	Päik-un-san	白 雲 山
No-ryöng	蘆 嶺	Päik-uöl-san	白 月 山
No-syang-ni	路 上 里	Päik-yang-san	白 楊 山
Nyö-chin-uön	女 鎮 院	Päing-nyön-san	百 年 山
Nyöng-uöl	寧 越	Pak-chhyön	博 川
		Pak-nai-jiang	福 內 場
		Pam-dong	栗 洞
		Pam-namu-dong	栗 木 洞
O-dai-san	五 臺 山	Pan-syöng	斑 城
O-man-tong	烏 蔓 洞	Pan-ya-dong	斑 也 洞
O-san-i-ri	五 山 二 里	Peuk-chhang	北 倉
Oa-ji	臥 卡	Peuk-chhyöng	北 青
Oa-tong	瓦 洞	Peuk-chin	北 鎮
Oan-do	莞 島		

P.

O.

Peuk-kyöi	北 桂	Pu-kö	富 居
Peük-tai-chhyön	北 大 川	Pu-ryöng	富 寧
Phan-keui-ri	板 機 里	Pu-yö	扶 餘
Phil-tong	筆 洞	Pul-da-san	佛 陀 山
Phc-phöng	葡 坪	Pul-kap-san	佛 甲 山
Pho-uön	浦 元	Pyök-dong	碧 湓
Phung-nam-ni	豐 南 里	Pyöl-hai-chham	別 海 站
Phyöng-an-do	平 安 道		
Phyöng-chhyang	平 昌		
Phyöng-gang	平 康		
Phyöng-san	萍 山	Sa-ri-uön	沙 里 院
Phyöng-yang	平 壤	Sai-mok	鳥 項
Pi-gok	稷 谷	Saing-keui-ryöng	生 氣 嶺
Pi-rai-san	飛 來 山	Sak-jyu	朔 州
Pi-ryu-gang	沸 流 江	Sal-phyo-djyöng	射 表 亭
Po-eun	報 恩	Sam-chhyök	三 陟
Po-syöng	寶 城	Sam-deung	三 登
Po-tök-uön	保 德 院	Sam-do-bong	三 道 峰
Pok-syu-san	伏 主 山	Sam-hak-kol	三 鶴 洞
Pong-hoa	奉 化	Sam-pho	三 浦
Pong-hoa-chhi	烽 火 峙	Sam-syu	三 水
Pong-hoang-san	鳳 凰 山	Sam-tari-gang	三 橋 江
Pong-nim-dong	鳳 林 洞	Sang-nyöng	朔 寧
Pong-san	鳳 山	Seung-thyön	昇 天
Pong-syö-tong	鳳 棲 洞	Sil-lyöng	新 寧
Pop-am	法 岸	Sin-chhyang	新 昌
Pu-cho-ri	富 只 里	Sin-chhyön	新 川
Pu-chyöl lyöng	赴 戰 嶺	Sin-gyöi	新 溪
Pu-gang	芙 江	Sin-jyang-dong	新 場 洞
Pu-hang-nyöng	釜 項 嶺	Sin-kokai	薪 峴

S.

Sin-mi-do	身彌島	Syök-syöng	石城
Sin-phung	新豐	Syöl-chhyön	雪川
Sin-sa-dong	新寺洞	Syöl-dol	立岩
Sin-säi-chhon	新間村	Syöm-jin-gang	蟾津江
Sin-tai-chhyön	新大川	Syön-chhyön	宣川
Sin-työn	新田	Syong-ak-san	松岳山
Sö-min-dong	蘇民洞	Syöng-chhyön	成川
Ssari-ryöng	柎嶺	Syöng-chhyön-gang	城川江
Sut-kokai	炭峴	Syong-hoa	松禾
Sya-chhang	社倉	Syöng-hoan	成歡
Sya-chhang-jiang	社倉場	Syong-jin-gang	松津江
Syang-dan	上端	Syöng-jyu	星州
Syang-dan-dong	上端洞	Syong-työng	松亭
Syang-gyöi	上溪	Syu-an	遂安
Syang-koang-dong	上光洞	Syu-dong	水洞
Syang-myön	上面	Syu-ryong-san	秀龍山
Syang-phum-ni	上品里	Syu-sai	秀山城
Syang-syö-dong	上西洞	Syu-syöng	主城
Syö-chyöi-san-tong	西祭山洞	Syuk-chhyön	肅川
Syo-heung	瑞興	Syun-an	順安
Syo-koam-yuk-ri	照館六里	Syun-chhyang	淳昌
Syö-pho	西浦	Syun-chhyön	順川
Syö-syong ni	西松里	Syun-thyön	順天
Syo-yang-gang	照陽江		
Syöi-chhyang	世昌		
Syöi-chyuk-chyung-dong	細竹中洞	Ta-tök-ri	多德里
Syöi-goi	細谷	Tai-an	泰安
Syök-am-ni	石岩里	Tai-bahoi	大岩
Syök-chyang-ni	石丈里	Tai-chhyöng-san	大青山
		Tai-dong-gang	大同江

T.

多德里
泰安
大岩
大青山
大同江

Tai-dun-san	大屯山	Thyön-ma-san	天馬山
Tai-ha-san	大河山	To-chhyön (To-ne)	刀川
Tai-heung	大興	To-chyang-tong	道壯洞
Tai-hu-jyu	大厚州	To-mak-dong	道幕洞
Tai-kak-san	大角山	To-tam	島潭
Tai-koan	大關	Tok-chhi	獨峙
Tai-koal-lyöng	大關嶺	Tok-chhyön	德川
Tai-ku	大邱	Tök-chyöng-ni	德貞里
Tai-ma-san	大馬山	Tök-hyön-tong	德賢洞
Tai-nyöng-gang	大寧江	Tök-to-uön	德道院
Tai-phyöng	大坪	Tök-yuk-ri	德元里
Tai-po-san	大寶山	Tong-chhang	東倉
Tai-syöng-san	大聖山	Tong-chhyön	洞川
Tal-gil-li	達吉里	Tong-pok	同福
Tal-ha-chhi	達河峙	Tong-työm	銅店
Tan-chhyön	端川	Tu-kai	斗介
Tan-syöng	丹城	Tu-man-dong	斗萬洞
Tan-yang	丹陽	Tu-man-gang	豆滿江
Tang-kokai	堂峴	Tyo-ryöng-goan	鳥嶺關
Tari-kol	橋洞	Tyo-tun-ni	鳥屯里
Thai-chhyön	泰川	Työng-jyu	定州
Tho-tari	土橋	Työng-nai-chhi	亭內峙
Thök-yu-ryöng	秋輪嶺	Työng-phyöng	定平
Thong-chhyön	通川	Työng-san	定山
Thong-sin	通信		
Thyöl-lyöng	鐵嶺		
Thyöl-uön	鐵原	U-gang	禹江
Thyön-an	天安	Ui-uön	渭原
Thyön-ho-san	天壺山	U-kok	雨谷
Thyön-hu-san	天吼山	Ul-san	蔚山

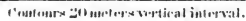
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Un-chhyong-gang	雲 籠 江	Yöi-syöng-gang	禮 成 江
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Un-san	雲 山	Yön-chhyön	連 川
Un-syöng-gang	雲 城 江	Yön-gi	燕 岐
Ung-keui	雄 基	Yön-pha-djyöng	烟 波 亭
Uöl-koang-ni	月 光 里	Yön-phung	延 豐
Uöl-pha	闊 波	Yön-san	連 山
Uön-am	元 岩	Yön-tai-dong	烟 臺 洞
Uön-jyu	原 州	Yöng-am	靈 岩
Uön-phyöng	院 坪	Yöng-chhyön	永 川
Uön-san (Wön-san)	元 山	Yong-chhyön	龍 川
Uön-syu-tai	元 帥 臺	Yong-chhyun	永 春
Uön-thal-li	圓 坦 里	Yong-chi-uön	龍 池 院
Uön-to-kol	院 基 洞	Yong-dam	龍 潭
		Yong-deung	龍 登
		Yong-dök	盈 德
		Yöng-dong	永 洞
Yang-bang	陽 凡	Yong-dyjön	永 龍 田
Yang-dök-uön	陽 德 院	Yong-gang	龍 江
Yang-gu	楊 口	Yong-goang	靈 光
Yang-mok	若 木	Yong-gung	龍 宮
Yang-pal-li	良 發 里	Yong-hai	寧 海
Yang-syök-dong	羊 石 洞	Yöng-heung	永 興
Yang-ti-chhon	楊 地 村	Yöng-heung-ha	永 興 河
Yang-yang	襄 陽	Yong-hoa-bang	永 龍 化 坊
Yö-jyu	驢 州	Yöng-il	迎 日
Yö-san	礪 山	Yong-moru	龍 隅
Yö-yang	呂 梁	Yong-pan-ni	龍 盤 里
Yöi-an	禮 安	Yöng-pyön	寧 邊
Yöi-chhyon	禮 泉		

Y.

Yöng-san	靈山	Yu-jyang	笠場
Yong-san-gang	榮山江	Yuk-sim-nyöng	六十嶺
Yong-tang	龍塘	Yul-chi	栗枝
Yöng-uöl	寧越	Yul-pho	栗浦
Yöng-uön	寧遠	Yu-syöng	輸城
Yöng-yang	英陽		

THE END





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